PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY, Limited,

167-177 TIMES BUILDING, NEW YORK.

Established 1874. Incorporated 1889.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 146 Franklin Street, Boston.

Western Office, 465 The Rookery, Chicago.

Philadelphia Office, 927 Chestnut Street.

SUBSCRIPTION, IN ADVANCE, ONE YEAR, $3.

(Including Postage in the U. S., Canada or Mexico.)

IN CLUBS of four or more, $2.50 a year each; with a free extra copy to the getter up of a club of 8. Foreign subscription, $5 a year.

In requesting your address changed, give **old** *as well as new address.*

ESTABLISHED 16 YEARS AGO, **THE ELECTRICAL WORLD is the Pioneer Electrical Journal of America and has well maintained its lead. It has a LARGER CIRCULATION than any other electrical periodical in the world, and is the BEST ADVERTISING MEDIUM.**

Correspondence, views and opinions on all topics within the province of this journal are cordially invited from any part of the world. We will thank readers to forward to us—**promptly** as they occur—**Items of News,** or information relating to any application of Electricity, also marked copies of their local papers containing anything likely to interest electricians. Anonymous communications cannot be noticed, nor can rejected manuscript be returned, unless accompanied by the necessary postage when received.

Advertising Rates are much lower than those of any other similar publication, circulation and standing considered, and vary according to space, position and number of insertions. Quotations promptly furnished.

For Sale Notices, Situations or Help Wanted, $1 to $2 an issue.

Address all communications to

THE W. J. JOHNSTON COMPANY, Ltd.,

Times Building, New York

OR ANY OF THE BRANCH OFFICES.

VOL. XVI. NEW YORK, JULY 5, 1890. No. 1.

CONTENTS.

EDITORIAL: PAGE.
Paragraphs ... 1

ILLUSTRATED ARTICLES:
Connection for Arc Lamps ... 2
Central Station Friction Gearing ... 2
A Lamp Hour Meter ... 2
Storage Battery Current Regulator ... 2
Otis Electric Elevator ... 3
Hall Automatic Block Signal ... 4
Edison System, Underground Electric Tubes ... 6
Indianapolis Railway Power Station ... 9
Experiments with Alternating Current Apparatus ... 10
Efficiency of the Transformer ... 11

MISCELLANEOUS:
New York Gas Commission ... 2
Tokyo Electrical Society ... 5
Exploration of Magnetic Field ... 8
Halifax Station ... 9
Underground Photography ... 9

SPECIAL CORRESPONDENCE:
New York Notes ... 14
New England Notes ... 14
Western Notes ... 14
Southern Notes ... 15
English Notes ... 15

NEWS OF THE WEEK:
Telegraph ... 15
Telephone ... 15
Electric Light ... 15
Applications of Power ... 15
Miscellaneous ... 16
Personal ... 16

INDUSTRIAL AND TRADE NOTES ... 16
ANSWERS TO CORRESPONDENTS ... 17
BUSINESS NOTICES ... 18
Our Illustrated Record of Electrical Patents ... 18

The Indianapolis Railway Plant. WE take pleasure in showing on another page cuts of the large and excellent power station at Indianapolis. The West has been particularly quick to see the advantages of electrical rapid transit, and one after another the larger cities are falling into line. The present station is an excellent example of the modern practice in central station operation, and will give some useful hints to all those immediately interested in the application of electric power, whether to the street railroad or otherwise.

Ill-Timed Temerity. THE Gas Commission is again growling and grumbling. It wants the earth—quite to the exclusion of electricity—and city lighting at its own price quite irrespective of the rights of others. The threat to go back to gas lack of lighting, however, must be taken as a refined sort of bluff, for the honorable body must surely know that the public would tolerate such an infliction for a very short time before its protests would be of a character not to be misunderstood or ignored. There is a point beyond which public patience will not go, and if any of the city officials are really desirous of locating it exactly we can suggest no more effective method than the one at present threatened.

New Application of the Accumulator. THE method of Mr. Mailloux for steadying a violently fluctuating load in electric power stations by the use of storage batteries merits some attention by reason of the unusal degree of ingenuity in the applications of electrical theory. The difficulties produced by wide variations of load in electric stations are well known, and if on trial the storage battery should be found to produce economically the result which in theory is evidently possible, it will prove a welcome addition to the resources of electrical engineering. Hitherto cost and short life for the storage battery have been serious objections to this extensive class of applications; but the accumulator of to-day is not at all that of two or three years ago, and it is to be hoped that experiments will demonstrate the practical usefulness of so valuable a servant.

Automatic Block Signal. WE present this week a rather complete account of an automatic block signal system that is attracting considerable attention from railway authorities at present. The electrical and mechanical details of this apparatus can hardly fail to be of interest to our readers. It is certainly very pleasant to feel sure that the dreaded rear end collision can be rendered practically impossible by such comparatively simple precautions, and it is only a question of time when the electric automatic signals will be found on every prominent line in the country. There are several such systems now in use on various roads, and they have as a rule commended themselves after severe trials. It is highly gratifying to see that the railroad officers are coming to have a keen appreciation of the value and wide applicability of electricity to the details of their enormous industry.

An Electrical Elevator. THE application of electric motors to elevator service has been discussed and attempted for some years, and several elevators have been constructed to run by electric power; but no very great degree of success has been attained in the matter until very recently. No service asked of a motor is more searching than this, with its incessant stopping and starting, and a peculiar form of motor was necessary to stand the strain. The elevator shown in our columns this week is operated by a modified Eickemeyer motor, constructed especially for this purpose and believed to fulfil the difficult requirements of the work with a fair degree of success. Those now in actual use in the Demarest building in this city have certainly proved admirable during the six weeks or more that they have been in operation, and with the present and growing facilities for securing cheap electric power in all cities having buildings large enough to require elevators, we are inclined to believe that the Eickemeyer-Otis elevator opens up another field for the displacement of steam by electricity.

In Distant Climes. A MOST encouraging feature of the development of the electrical industries is the rapidity with which they are spreading to distant parts of the world. In South America, in the far East, and in many countries where the railroad is as yet somewhat of a curiosity, the electric light, the telegraph, telephone and motor are all becoming familiar to the most sequestered inhabitant. As showing that electricity can make friends where some modern discoveries are still strangers, the note in our columns this week concerning the Electrical Society at Tokyo possesses more than a passing interest. An organization over a thousand strong shows that electricity has already a large number of devotees on the further shores of the Pacific. We have not yet heard of the organization of the Tanganyika Electric Club, or the Congo Falls Telegraphers' Association; but we have no doubt that Africa will soon join her sister continents in keeping pace with the advance of electrical industry.

Foucault Currents in Transformers. PROFESSOR RYAN'S paper dealing with this topic is rather of theoretical than practical interest, as the subject of the experiments was a transformer of a type only suited for exhibiting the effects described. In the commercial instrument the lamination of the core is so effective as to reduce the Foucault currents to a very small quantity. Nevertheless, it is well worth knowing that heating does not make an appreciable difference in the energy lost in hysteresis. In the discussion that followed this contribution to electrical theory a point so interesting was raised that it should properly be mentioned here. What efficiency could be obtained by using a transformer entirely without iron at an enormously high frequency? In such a case the losses would be almost entirely due to heating of the conductors, and consequently would increase with the output. The all-around efficiency would, therefore, be higher than at full load, a very valuable property. It is to be hoped this question will be the subject of experiment at no distant date.

Some additional Improvements. WITH the beginning of Vol. XVI. of THE ELECTRICAL WORLD we have thought it advisable to introduce a few slight changes in the make-up of the journal, which we feel sure will be welcomed by our readers. The most noticeable alteration is the omission of the rules hitherto used at the head of the page and between columns. This step has of late been taken by many of the most carefully edited newspapers in the country, and in the opinion of expert journalists is a gain both in appearance and in convenience. In the departments we have added a column devoted to Industrial and Trade Notes, and another devoted to Answers to Correspondents. The number of letters of inquiry received has of late increased to such an extent that it is found necessary to devote additional space to our inquiring friends. Hereafter, therefore, Answers to Correspondents is to be a regular department, and inquiries of general electrical interest are solicited.

Efficiency of Transformers. THE paper of Humphrey and Powell, published this week, is peculiarly instructive. So little is really known of the working efficiency of alternating current transformers that an exhaustive study like the present is especially valuable. The figures obtained for the efficiency are very high, particularly in the case of all around operation, so high indeed that one instinctively begins a search for constant experimental errors. It is a pity that the experiments did not measure the outputs of both primary and secondary by similar and easily comparable methods. The difficulty of the work would have been somewhat enhanced, but the results would have been more satisfactory. A very valuable check on the accuracy of the work could have been obtained by the use of the excellent calorimetric method of testing brought into notice by Dr. Duncan. As all the energy consumed in the transformer must ultimately appear in the form of heat, and alternating currents are not easy to measure exactly, such a test is particularly desirable. Still it is quite evident from the results obtained that the transformer has been undergoing a process of evolution that has resulted in marked improvement in efficiency.

The Edison Tube System. IN the present issue will be found an elaborate account of the underground tube system of the Edison Company, of which menfion has been not infrequently made in our columns but which now for the first time is exhibited in its entirety. This system represents the most elaborate development of the electric main system as distinguished from a special system of subways. It is unnecessary to say that it possesses great advantages over this in the matter of flexibility, whatever may be their relative merits otherwise. The difficulties that have been met by the Edison Company in developing their system have been great, but one after another they have been successfully overcome until the present form, a more than usually practical method of running underground wires, has been reached. The minute details have been worked out with a great deal of care and skill, and the result reflects great credit on the ingenuity that has produced it. The question of underground electrical subways is one of immense importance in large cities, and electricians will be particularly interested in watching the growth of the various mechanical means for running and protecting the wires. It will probably be a long time before there is any general unanimity as to the best process of effecting the desired result, but the present one has already stood the test of quite severe service and seems worthy of careful consideration on the part of the electrical public.

A Remarkable Verdict. THE coroner's jury in the case of Bastiano Ipolito has brought in a verdict attributing to an electric lighting company the blame for Ipolito's death. The facts in the case hardly seem to warrant the conclusion reached. The unfortunate man stood upon an iron bracket, many feet from the ground, in a spot reasonably denominated inaccessible to the general public. He had climbed there for the purpose of washing windows, and he was wet from head to foot. He slipped, and would have fallen to a different death, or at least to serious injury, had he not seized an electric light wire. It is not surprising that this wire, in such a position, was not perfectly insulated. That the man was allowed to climb into this situation, dangerous without regard to the neighboring wire, was the blamable cause of his death. The coroner's jury might well have censured the officers of the bank for permitting or constraining an employé to stand upon a bracket placed high in the air, and intended only to support a sign-board. Let us suppose, for example, that the next man to meet with Ipolito's accident grasps a *dead* wire, and, the wire breaking, the man falls to the street and is killed. Will the coroner's jury accuse the electric company of manslaughter on the ground that its wire should have been strong enough to remain intact when seized by a falling workman? The two cases are indistinguishable. Sensible people will not blame an electric wire if it fails to save them from fatal accidents.

The New York Gas Commission.

The anomalous position of the city and the electric lighting companies in regard to the street lamps, which has existed since May 1, was the subject discussed at a meeting of the Gas Commission held in the Mayor's office June 26. The electric lights have been lighted now for sixty nights without any definite understanding as to the price to be paid per lamp. The bids for this year's lighting (from May 1) were about 25 per cent. above last year's prices, owing to the great expense of subway wiring; but the city neither accepted nor rejected the bids. Meantime the lights have gone on burning: at the prices bid, say the companies; at the old prices, claims the city. Whether this dispute will be pushed by the companies or not, the Gas Commission has now rejected the bids (as it should have done over two months ago), and has advertised for new proposals. The commission, in asking for bids on the one hand, holds a club in the other, in the form of a threat to return to the ancestral gas flicker should the companies not offer to do the lighting at figures satisfactory to his Honor the Mayor.

A New Connection for Arc Lamps.

It was long ago conceded by managers of arc-lighting plants that the most marked improvement in the service could be obtained by a careful attention to the details of the various parts of the system. No link in the chain of an arc light service requires so much attention as the lamp itself. Many of the minor troubles which occur with arc lamps and their remedies were pointed out by Mr. M. D. Law at the last meeting of the National Electric Light Association. To these may be added the trouble of flashing of the lights and open circuits caused by the uncertainty of the swinging connection in the hooks by which the lamp is hung from the supporting board above. The accompanying illustration represents a neat and useful device, for which the Pettingell-Andrews

FOR T.-H. LAMP. FOR BRUSH LAMP.

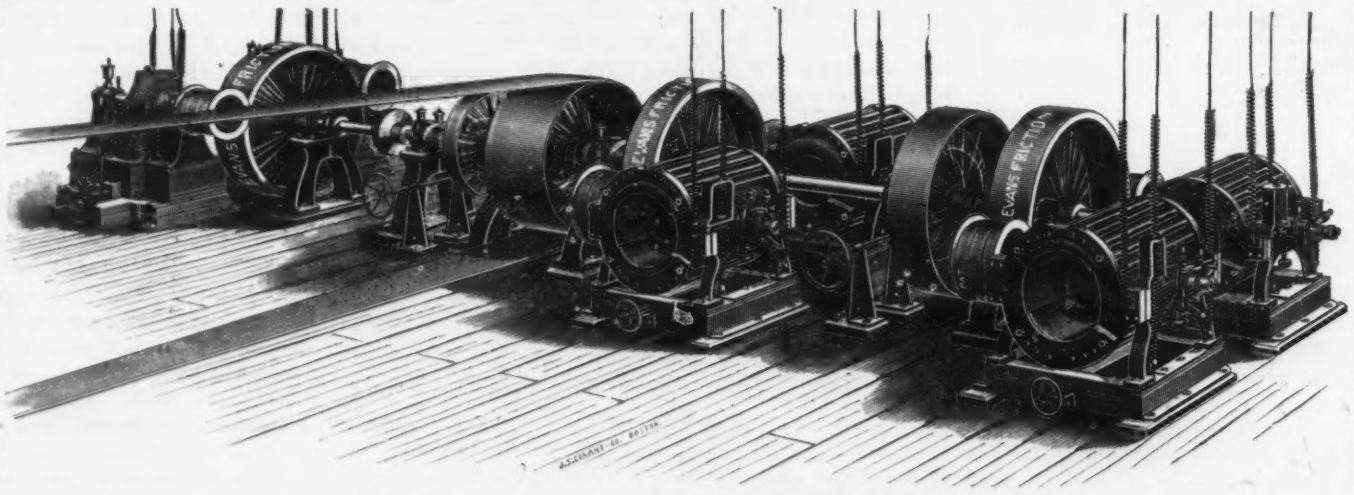
Arc Lamp Connections.

Company, of Boston, is the agent, called the safety connection cap, intended to produce a positive connection between the hooks of an arc lamp and the hanging board. This new style of connection prevents an arc from forming between the hooks and avoids the annoyance arising from that trouble. There is no danger of a lamp being shaken or blown from its hooks and all liability to trouble from swinging connections is removed. Although the illustrations show the connection as made for only two arc lighting systems, it is made to fit the lamps of any manufacturer and can be used on any system.

Friction Gearing in a Central Station.

The problem of connecting a dynamo with any prime mover in such a way as to secure smooth and steady running at the proper speed is one for which a comparatively limited number of solutions have been offered. Modern practice is almost exclusively confined to belting, although a few rope-driven and direct coupled machines are now in use. Our cut shows an extensive and very successful application of that ingenious compromise plan — the Evans friction cone. It has been illustrated before in our columns, and since its first appearance has been gradually working its way into use as a valuable means of operating machinery, especially in cases where space is limited. The cut is of the station at Attleboro, Mass., which is owned by the North Attleboro Steam and Electric Company and the machines in it are operated exclusively by the apparatus of the Evans Friction Cone Company. The line shaft shown in the cut is driven from a compound Ide engine by means of an ordinary belt. At the extreme left will be seen two 60 h. p. Thomson-Houston railway generators, both running upon the same circuit. These railway generators are a specially severe test of any driving apparatus, for the load varies from nothing at all to 140-h. p. many times an hour. On the right side of the cut there are four of the well-known Thomson-Houston arc machines, each having a capacity of 50 1,200 c. p. arc lamps and each machine fully loaded in practice. The speed of the line-shaft is 300 revolutions, while the speed of the railway generators is 1,150 and of the arc dynamos 820.

The company is now putting in another large engine, and will belt it directly to a continuation of this line shaft and connect it by the present shaft to the clutch coupling. On this continuation there will be more dynamos placed also to be driven by the Evans system. It will be observed that the dynamos are so arranged that one pulley drives two machines, and in such a manner that each dynamo can be stopped and started independently of its fellows without slowing down the engine. By putting two dynamos in this way upon a single pulley, pressure on the shaft bearing is relieved and the plant gains in compactness The plan of this frictional driving seems to answer the purpose admirably, and ought to be specially valuable for marine plants and other stations where it is useful to secure the compactness of direct coupling without the inconvenience of high speed of engine or low speed of dynamo.



FRICTION GEARING AT NORTH ATTLEBORO, MASS.

Direct Measurement of Current in Lamp Hours.

Central station lighting for large areas has recently made great advances, and current for incandescent lamps is now distributed to districts quite remote from the stations. This is partly due to the fact that the competition between the direct and alternating current systems of distribution has tended to extend the area supplied by

A Lamp-hour Meter.

each station. In this way many places that had not installed an isolated plant have been supplied by incandescent lamps from central stations. The usual basis of charges for the current supplied has been the number of lamp hours at the consumer's place, *i. e.*, the number of lamps multiplied by the hours during which they were burning. In many places where the lights are manipulated by gang switches, the lamps controlled by each switch are all turned on or off together. Then it is only necessary to keep count of the number of hours they were burning in order to compute the charges.

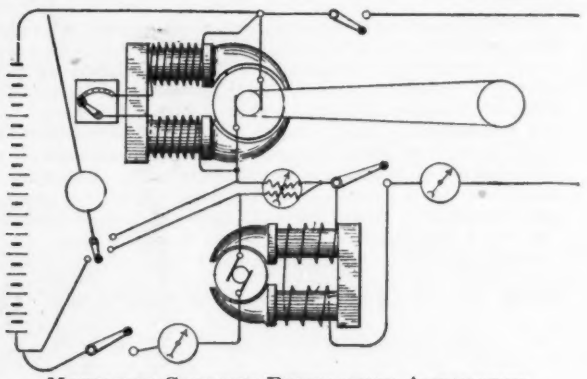
Most of the meters on the market will give the number of hours only indirectly, hence there is need of a simple and trustworthy counter for use with incandescent lights. This seems to have been met by Pattee's Electric Lamp Hour Recorder, an instrument now being brought out by the Great Western Electric Supply Company, Chicago.

The cut shows it with the door of the inclosing case opened. A clockwork, with two powerful springs, intended to run the recorder 720 hours, has three dials registering the hours and the tens and hundreds of hours. The inverted horseshoe magnet, mounted on a brass plate below the clock, has its coils connected in series with the German silver resistance shown beside it, the whole being connected in shunt with the lamps. The armature of the magnet is hung from a slender rod, and by its weight acts through a bell-crank lever as a brake to the escapement-wheel of the clock. When the current to the clock is turned on, the armature is drawn up, and, acting on the lever and brake, at once releases and starts the escapement. As soon as the current is stopped, whether by the switch or by the shutting down of the station, the armature falls and stops the clock. Thus the clock runs only when the lamps are burning, and the dial readings give the number of hours directly.

The whole apparatus is well built, and seems to have nothing about it that could get out of order. The German silver wire is wound on a bobbin with perforated heads, and has air spaces between the layers. The turnbuckle shown in the middle of the rod, to which the armature is fastened, serves to adjust the play of the armature and its distance from the magnet poles. The lever, slide and brake are very neatly arranged, giving a positive start to the escapement and stopping it instantaneously. The recorder is mounted in a walnut case like a clock, the dial being visible through a glass plate. A clock assures the current supplier that the instrument is not being tampered with, while the direct reading dial should give the consumer confidence in the correctness of the readings. As ordinarily built the coils have such a resistance that on a 110-volt circuit the energy consumed is only 10 watts. By suitably varying the resistance, the Pattee recorder can be adapted to currents of any pressure. Moreover, it can be adapted to multiple, series, series-multiple or multiple-series lines, and may be used with either alternating or direct currents.

The Storage Battery as a Current Regulator.

The variable load upon electric lighting and power circuits is sometimes a great inconvenience, and especially is



Mailloux Current Regulating Apparatus.

this true on the railway plants now becoming so common. Here the load may jump instantly from nothing to the full capacity of the machines, producing sudden and severe fluctuations that cause great strains in the engine, dynamo and entire machinery, materially increasing the cost of repairs. At the same time there is also produced a fluctuation of the electromotive force, owing to the fact that even the best engines cannot govern quickly or accurately enough to follow such rapid and extensive variations as are met with in street railway practice. Even compound winding, separate excitation and the like cannot entirely succeed in keeping a constant potential, as the success of these expedients depends on speed being maintained constant. An additional inconvenience from excessive variations of load is that it becomes necessary to provide an engine large enough to handle the full load at its normal output. Therefore the engine is habitually worked far below its point of maximum economy. To avoid these well known difficulties Mr. C. O. Mailloux has devised an ingenious application of the storage battery with the specific purpose of lessening the variations of load of the dynamos by reinforcing them at the proper time from the battery.

In his arrangement, as seen in our cut, he provides a storage battery in which energy will be stored at times when the load is light, but becomes valuable in the working circuit in connection with the supplemental generator when the load is heavy, so that the increase may be taken care of without causing a material addition to the output of the engine and generating machinery. This supplemental generator has its armature in the branch with the compensating storage battery, and is run during the operation of the plant with a polarity such that its electromotive force shall oppose that of the charging current and shall assist that of the discharging current of the battery. Its electromotive force is automatically controlled by fluctuations on the main circuit in which compensation is to

be effected. This may be accomplished by means of regulating resistance coils, shifting the brushes, or by any of the well-known means of varying the power of the machine.

In the cut the main generator is shown as a shunt-wound machine. The supplemental generator is of small size and in circuit with the batteries. It is so arranged that its electromotive force will add itself to that of the storage battery during the period of discharge. It is obvious, therefore, that this electromotive force will, while the machine is in operation, oppose the current from the main machine in the operation of charging the battery. In the operation of the system both the armatures are revolved at their respective speeds with the application of power from the same or different sources.

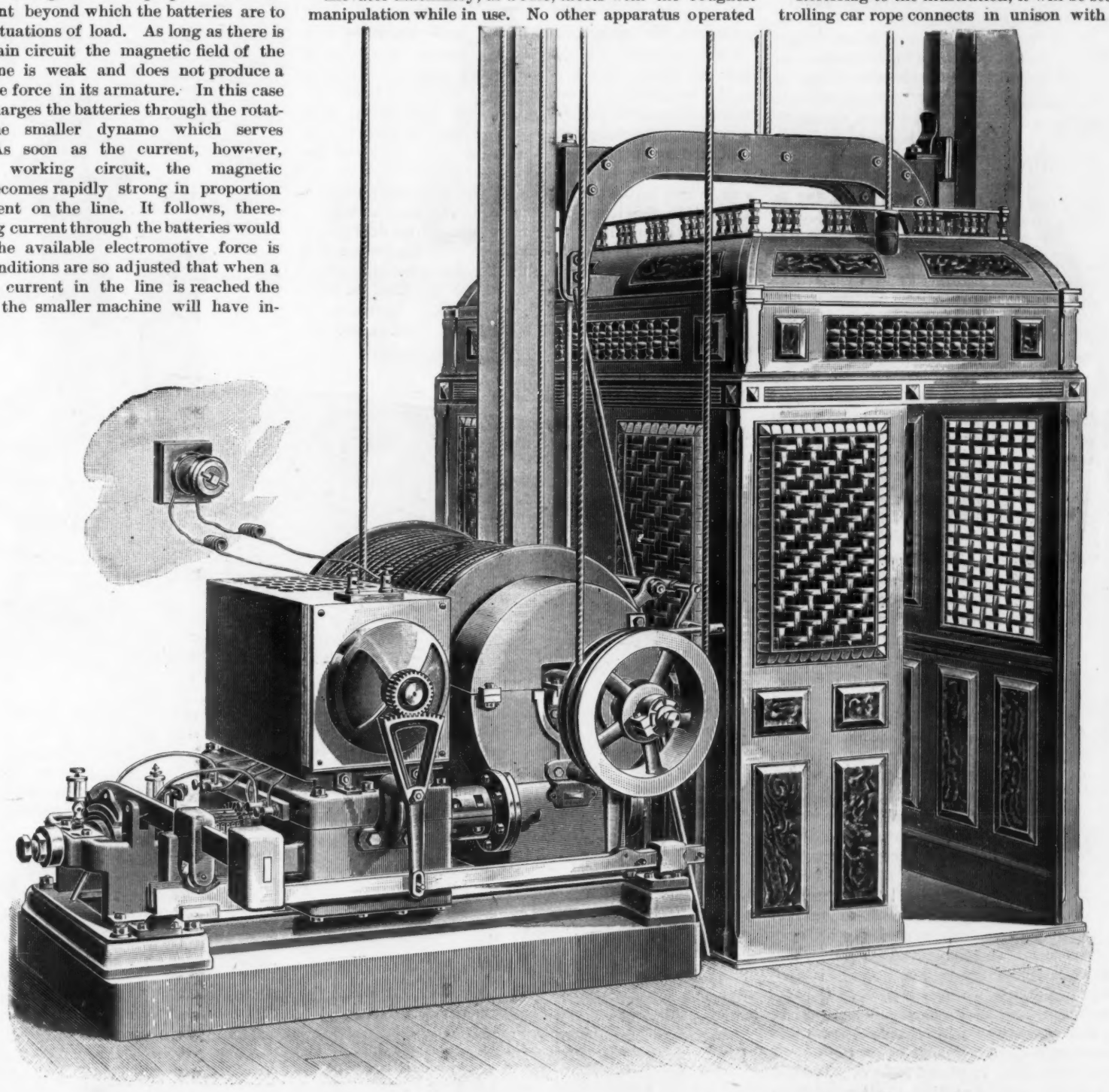
The number of cells in the storage battery is proportioned in accordance with the potential used, as is also the winding and the speed of the supplementary generator. This is provided with separate excitation from series windings in the main line of the large machine proportioned with reference to the current beyond which the batteries are to assist in checking fluctuations of load. As long as there is no current on the main circuit the magnetic field of the supplementary machine is weak and does not produce a powerful electromotive force in its armature. In this case the main generator charges the batteries through the rotating armature of the smaller dynamo which serves as a resistance. As soon as the current, however, is sent over the working circuit, the magnetic field, before weak, becomes rapidly strong in proportion to the amount of current on the line. It follows, therefore, that the charging current through the batteries would be reduced, because the available electromotive force is also reduced. The conditions are so adjusted that when a certain value of the current in the line is reached the electromotive force of the smaller machine will have increased sufficiently completely to neutralize the charging current. A little further increase in the line current and the battery is thrown into action, assisting the main generator in supplying the necessary current. It is worth noticing that a slight reduction in the electromotive force, due to the slowing of the engine under a sudden load, will press the batteries vigorously into service. In effecting this compensation the energy required by the small dynamo is abstracted from the prime mover, but this amount is insignificant compared to the total extra load thrown on the machine. On a 500-volt circuit the smaller dynamo would not need to raise the potential in the compensating circuit at any time above 60 volts. If now the normal current of say 50 ampères jumps up to 125, then estimating that the battery and small dynamo together take up the entire extra load of 75 ampères, the proportions furnished by the small dynamo would be only about 4,500 watts, while the battery would furnish 33,750. Thus the prime mover furnishing power for both dynamos would have an additional load of less than 10 h. p. during fluctuation, which would otherwise increase the load by 50 h. p.

Several other arrangements of the apparatus are proposed by Mr. Mailloux, but the present is enough to show he exceedingly ingenious nature of his invention. The arrangement will unquestionably smooth out the fluctuations in load to a very great extent, and unless the cost in maintenance of the storage batteries should be found on trial to be excessive it should prove a useful addition to electric power plants.

The Otis Electric Elevator.

With the rapid introduction of electric light and power stations into nearly every city and town in the civilized world, a trustworthy source of power of unsurpassed cheapness has been made available for the performance of work needed for domestic service in buildings of every description; yet, notwithstanding the many advantages of this motive power, its safety, simplicity, extraordinary efficiency, absence of noise, smell, smoke, ashes and heat, also freedom from liability to damage by frost or by unskilled attendance—in spite of all these, its adaptation for elevator service presented many difficulties.

Elevator machinery, as a rule, meets with the roughest manipulation while in use. No other apparatus operated by electric power is exposed to such strain--not even in street railroad service, where at least the same operator is constantly in charge and a systematic inspection considered indispensable.



EICKEMEYER MOTOR USED TO OPERATE AN OTIS ELEVATOR.

By carefully considering these special conditions, Otis Brothers have succeeded in perfecting an electric elevator, which is well suited to many places where it has heretofore been impracticable to use such an apparatus. The winding machinery and safety appliances (including the safety governor, the gravity wedge safety, the automatic stop motion, the slack-cable stop and the devices for controlling the movement of the elevator car) are such as they have been constantly building for the past 25 years; consequently, in the elevator proper, there are no experimental features. To give motion to the elevator machinery they connect therewith, and make a part of the same, the very ingeniously constructed motor shown in our illustration (invented by Mr. Rudolph Eickemeyer, of Yonkers, N. Y.), which possesses many novel and meritorious features, especially adapted for elevator service, for which it was expressly designed. This motor, when so combined with the elevator, stops and starts with a gradual movement, and consumes power only in proportion to its load, and only while the elevator is in use, thus effecting the greatest economy in consumption of power. It possesses in a high degree the best points of motor construction and the highest efficiency yet obtained. Simple and accessible in all its parts, of the best material to meet electrical and mechanical requirements, it is protected by its unique construction, which makes the motor completely iron-clad, without adding any unneccessary weight. It has, further, the special advantage of a powerful field and the shortest possible magnetic circuit, which entirely prevents sparking at the commutator, and affords perfect self-regulation. It may also be added that, although it possesses a very strong magnetic field, yet there is no external magnetism in the machine, and consequently there is no danger of damaging a good watch, even if placed on top of the casing. The motor is so coupled to the elevator gear that it starts and stops with the winding machinery, the whole being under perfect control of the operator in the car, thus forming a single apparatus, free from jerky and irregular running of detached gearing, as when operated by belts.

Referring to the illustration, it will be seen that the controlling car rope connects in unison with the switch and the brake by means of the steel bar running across the base of the apparatus. An indentation in this bar (into which a wheel supporting the brake weight settles when the current is turned off) makes simultaneous the action of brake and switch. When the toothed wheel operating the switch is at centre (as in the cut) the brake is lowered into the indentation in the bar, and the weight, applied directly to the armature shaft, stops the motion of the armature. When the steel bar is moved in either direction the current is turned on and the brake raised.

The machine here shown (of which there are two now in satisfactory operation at the Demarest building, Thirty-third street and Fifth avenue, New York) is of 5 h. p., and operates an elevator with a capacity of 1,500 pounds and a speed of 110 feet per minute. The current is supplied from the Twenty-sixth street Edison station, and the voltage is 220. The armature makes 800 revolutions per minute, and is connected by worm gearing to the drum, which revolves but ten times a minute.

The difficulties heretofore experienced from heating and "burning out" have been effectually guarded against in the construction of this machine, and, in connection with the operating device, an indicator is employed which at all times shows the operator in the car the exact position of the controlling and reversing switch on the motor.

The Hall Automatic Block Signal System.

The papers and discussion at the late meeting of the Association of Railway Telegraph Superintendents show the keen interest taken by the great railway corporations of the country in the development of the block system. On lines where traffic is light and trains infrequent the old methods of running are sufficiently successful, but with the enormous growth of railroading interests there arises a necessity for extreme precautions in train-operating to secure safety on overcrowded lines. The block systems in use in England rapidly found their way into this country; but while on the other side of the water comparatively little has been done toward the automatic completeness of the system, we have now in various stages of development several automatic block signal systems of an electrical character that promise to become yearly more and more important in railway work.

The general principle of all such systems is the opening or closing of an electric circuit by a train entering a given section of line so as to display a danger signal to all following trains until the circuit is again operated to remove the danger signal by the passage of a train in the block on to the next section. The principle is simple enough, but all sorts of difficulties have been met with in the application. It would seem an easy matter to open or close an electric circuit by the passage of a train, but in practice it has proved quite the reverse. Two things must be considered as necessary to the success of any such automatic system. In the first place, it should be so arranged that no accident short of demolition of the signal can prevent displaying the danger system when the train enters the section. In the second place, accidental showing of the danger signal is to be as far as possible avoided to prevent unnecessary delays.

Fig. 1.—Signal Post.

We illustrate on these pages an automatic block signal system that has met with uniform and deserved success in its application on some of our prominent roads, and that is worthy of careful study as being a type of the modern development of automatic safety appliances. We show a diagram of a typical section of track, with the electrical connections used. At the entrance to the section is placed the track instrument (Figs. 3 and 4) which will be described later on. Suffice it to say that it is operated by the passing train and breaks an electrical circuit. A similar instrument at the other end is called the clear track instrument, its function being to restore the signal to a safety position. The two instruments are alike in principle and construction, except that the first keeps the electric circuit closed while in its normal position, while the second keeps the circuit normally broken. This latter is placed 1,500 or 2,000 feet beyond the end of the section, so that the longest train will be wholly clear of the section before the first wheel touches it. The block track instrument at the entrance of the section is designated by the letters *CS*, while the clear track instrument is marked *OS* (Fig. 2). *R* is the relay and *X* the battery. These may be placed at any convenient point. *D* is the signal instrument, carrying a disc mounted on the end of a rod and counterpoised by a weight at the other end. The central portion of the rod bears the armature of the electro-magnet shown in diagram, and when the circuit is broken, the disc being heavier than its counterweight falls by gravity, bringing the rod into a position parallel to the cores of the magnet. The circuit is normally closed, and the signal *D* is held at safety, the line being complete from battery *X*, through wire 1, track instrument *CS*, wires 2 and 3, electro-magnet *S*, wire 4, contact point *p*, wire 5, electro-magnet *R*, wire 6, to battery. The train on entering the section opens this circuit, the first wheel of the track train breaking the contact in the track instrument *CS*. Electromagnets *R* and *S* are then demagnetized, the signal *D* falls to danger and the contact to *p* is broken. After the whole of the train has passed over the block instrument the contact in *CS* is restored, but as the circuit is now broken at *p* the signal will remain at danger until the points at *p* are again brought in contact by the train passing out of the section and operating to contact maker at *OS*. As soon as the contact at *p* closes, the signal circuit is complete, and remains so until the train has entirely passed the clear track instrument. Until this time the signal remains at danger, for so long as the spring in *O S* maintains contact two circuits are complete—one through the clear track instrument and the relay magnet and the other through the block track instrument, signal magnet and relay magnet. The resistance of the latter circuit being much greater than that of the former, the signal will remain at danger so long as the clear track instrument spring maintains contact, which by means of an air cushion in the instrument hereafter to be described will be long enough to admit of the passage of a train at ordinary speed. It will be seen that making connection at *O S* is equivalent to crossing the wires 7 and 9 and that therefore an accidental crossing of these wires would cause a display of the danger signal. The crossing of wires 1 and 4 will produce precisely the same effect. All the operations of the signal are by positive closing or opening of the circuit, which is effected by making and breaking a metallic contact in the track instruments. The disc is held at safety by a very light current and needs no delicate adjustments. Where there are switches in the section each switch is connected to a circuit breaker inserted in wire 1 (Figs. 6 and 7.) The throwing of the switch from the main line opens the circuit and causes the danger signal to appear just as if a train had opened the circuit at *CS*. By this system it is clear that the presence of a train on any given section will display the danger signal to anything following it until it has passed completely out of the section on to the next.

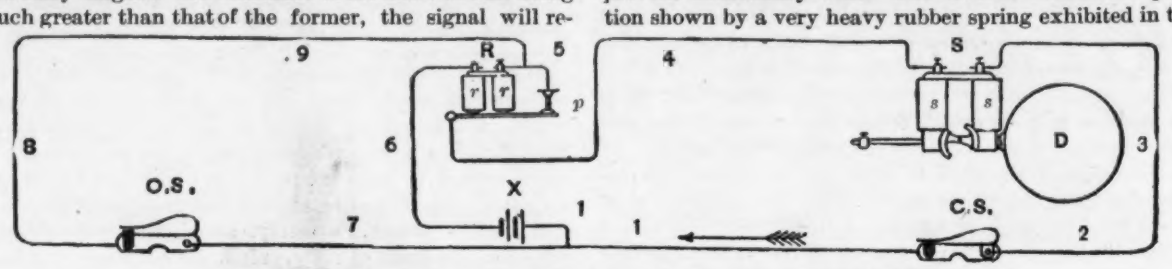


FIG. 2.—HALL BLOCK SYSTEM—DIAGRAM OF CONNECTIONS.

The electrical circuits are simple enough, but the success of the system is due as largely to the care with which its mechanical details are worked out as to any electrical ingenuity displayed in its construction. No amount of electrical perfection will make a trustworthy automatic signaling apparatus unless the movable parts are so arranged that they cannot fail to operate the signal circuit. The track instrument (Figs. 3 and 4) has in great measure made the success of the whole system. It is an exceedingly ingenious bit of apparatus, very strong in construction and, as some years of experience have shown, very certain in action. Fig. 3 shows the outside view, Fig. 4 a section. It will be seen that the apparatus is placed on a tie alongside the track with the extreme tip of the lever shown in the cut just clearing the outer edge of the rail and a small fraction of an inch above it. This contact end is provided with a hardened steel surface to prevent unnecessary wear. The lever is held in the position shown by a very heavy rubber spring exhibited in the cuts, which will not yield perceptibly except to a very heavy blow. The other end of the lever enters the track instrument proper. This is a massive iron casting with an accurately cylindrical bore from two to three inches in diameter, to which is fitted a metallic piston solid with the steel piston rod, the lower end of which abuts against the end of the track lever and the upper end of which passes through a nicely fitting bearing at the top of the cylinder. Through the top of the cylinder there is an air-port provided with a valve, which can be regulated to produce any amount of cushioning desired. The top of the piston rod is conical in its general shape, and operates and acts directly upon the contact make or break which is shown in Fig. 4. In its normal position the contact piece which operates the circuit breaker rests against the conical end of the piston rod near its top. When, however, a car wheel depresses the outer end of the track lever the piston rod is given a sudden blow and flies upward, its conical end pushing over the contact piece and breaking the circuit. As the air valve, controlled by the little spring seen in the figure, is

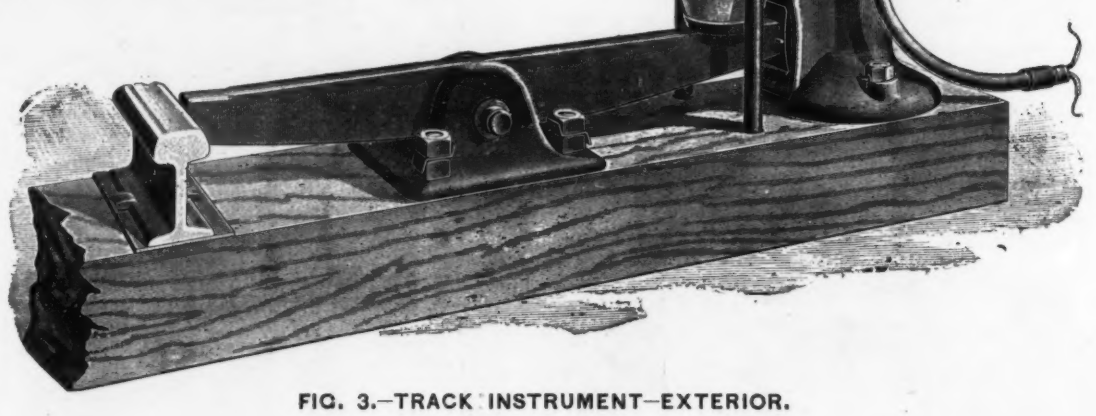


FIG. 3.—TRACK INSTRUMENT—EXTERIOR.

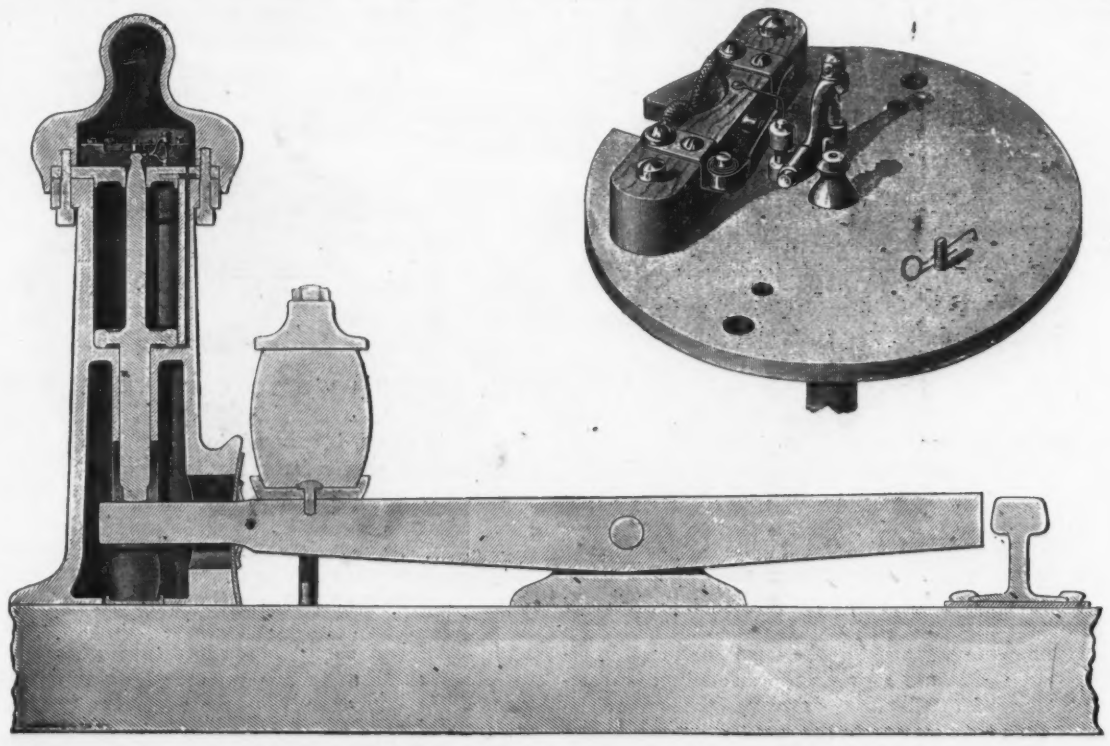


FIG. 4.—TRACK INSTRUMEMT—INTERIOR.

opened or closed, the time of descent of the piston rod can be shortened or lengthened. The contact apparatus is protected by a massive cast iron cover fitting very closely and securely bolted on. A chamber almost air-tight is thus provided, and the contacts protected against the injurious effects of dampness and dust. The exceedingly massive structure of the whole has been found necessary to secure the proper amount of durability. The track instrument *O S* is precisely similar in its construction, except that the conical point of the piston rod serves to close the circuit instead of opening it, and the air-cushioning holds it open for a reasonable length of time.

The signal instrument is seen in Fig. 5, and consists merely of an electro-magnet of considerable power with an armature to which the signal disc is directly attached. When the circuit is closed the armature is pulled up into the position that gives the shortest length of the lines of force and the danger signal is consequently out of sight. When, however, the circuit is opened the danger signal falls by its own weight. The peculiar shape of the armature employed makes it possible to secure movement over a considerable distance without materially weakening the attracting power of the magnet. In the danger position the tips of the armature are still close to the poles of the magnet and clearing them by a slight air space, so that in no position of the armature is the magnet likely to fail to produce its proper effect. The weight of the moving parts is reduced as much as possible, aluminum being freely used in their construction. The whole arrangement, as will readily be seen, is exceedingly simple, and as the signal is inclosed in a tight case it would be almost impossible for any series of accidents short of demolition of

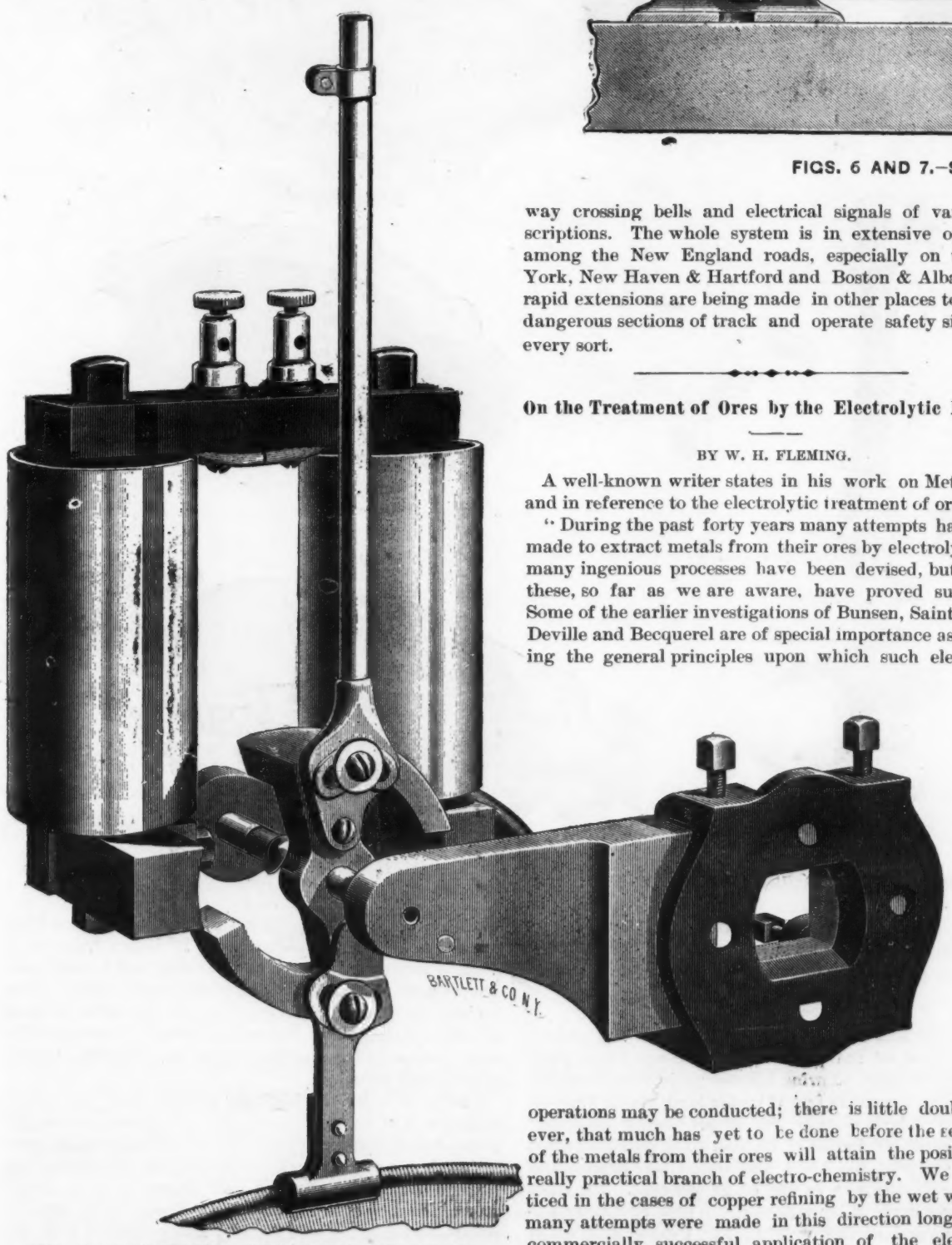
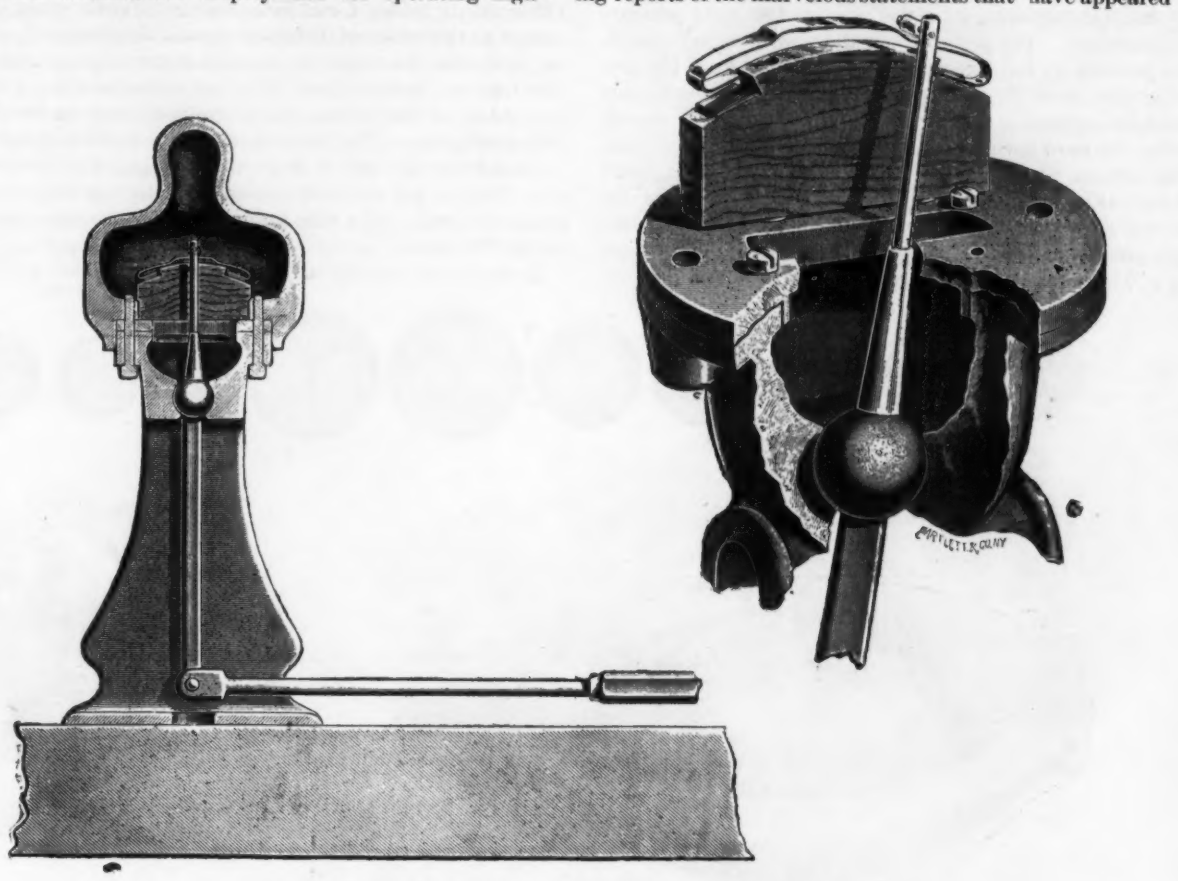


FIG. 5.—ELECTRICAL MECHANISM OF SIGNAL.

the apparatus to prevent the signal disc falling into danger when the circuit is broken. A signal post of the form ordinarily employed is shown in Fig. 1, the red danger signal being withdrawn from view by the action of the magnet. The switch instrument (Figs. 6 and 7) is very similar in its general solidity of design to the track instrument, but its action is even simpler. A single bar attached to the switch lever at its lower end is pivoted by a ball and socket joint that closes the chamber in which the contacts are located and bears on its upper end an arm with an insulated contact roller which operates the phosphor bronze contact spring shown on the top of the detailed cut. In the position shown the danger signal would be displayed. The track and switch instruments may, of course, be used for other purposes than the operation of anything like the block system, and have come into considerable employment for operating high-



FIGS. 6 AND 7.—SWITCH INSTRUMENT—INTERIOR.

way crossing bells and electrical signals of various descriptions. The whole system is in extensive operation among the New England roads, especially on the New York, New Haven & Hartford and Boston & Albany, and rapid extensions are being made in other places to protect dangerous sections of track and operate safety signals of every sort.

On the Treatment of Ores by the Electrolytic Method.

BY W. H. FLEMING.

A well-known writer states in his work on Metallurgy, and in reference to the electrolytic treatment of ores, that:

"During the past forty years many attempts have been made to extract metals from their ores by electrolysis, and many ingenious processes have been devised, but few of these, so far as we are aware, have proved successful. Some of the earlier investigations of Bunsen, Sainte-Claire, Deville and Becquerel are of special importance as indicating the general principles upon which such electrolytic operations may be conducted; there is little doubt, however, that much has yet to be done before the separation of the metals from their ores will attain the position of a really practical branch of electro-chemistry. We have noticed in the cases of copper refining by the wet way that many attempts were made in this direction long before a commercially successful application of the electrolytic method was arrived at, and we still hope and believe that electricity will be practically employed in extracting metals from their ores; indeed, some trials which we have recently made in this connection are at least of a very hopeful character."

This paragraph could now well be eliminated from his work. Electrical engineering firms for the past three years have given this branch of the profession great attention, and with the result that their efforts in constructing dynamos especially adapted for this work have been successful. The United Edison Company, with their unusual facilities for manufacturing generators, promptly exploited this field, and are now turning out dynamos to develop any amount of current requisite for the capacity of the works treating the ores.

Many mine owners and operators of existing plants treating ores in the old method have, from time to time, been considerably exercised in their minds in reading and hearing reports of the marvelous statements that have appeared about the output of the establishments already provided with plants for treating copper ore electrolytically.

1. The pureness of copper deposited.
2. The recovery of the gold and silver, obtained by no other method.
3. The cheapness of production.
4. The ready sale of the product.

These statements are so far true, but the owners, on investigating the matter, have had great obstacles thrown in their way, getting no information as to the construction of the plants, and being told that the method is altogether conducted in a secret manner. This consequently has dampened their ardor and they have returned to their old system of conducting their operations. But it may be at once stated that there is no real secret process; owners of electrolytic plants have only adopted the ordinary wise and business caution of, when they have a good thing, keeping it as far as possible to themselves. The United Edison Company, with a thorough knowledge of the whole system, can now contract with parties to furnish them with a complete plant, including motive power and generators, baths, pumps, and all the necessary information for conducting with financial success the operations of treating any ores by the electrolytic method.

The Electrical Society of Tokyo, Japan.

This Society was formed about two years ago and has for its object the instruction and advancement of its members in those branches of science in which they happen to be most interested, or in the industrial uses and applications of which they are employed. The membership at the present time is not far from 1,100, most of whom, like the members of the sister societies in Great Britain, are very largely interested or engaged in telegraphy. The *Transactions* of the Society, which are published once a month, contain papers that have been read before the Society, other articles of an instructive nature and a carefully compiled index to the current literature upon technical subjects.

The third national exhibition now being held in Tokyo has brought together an unusually large number of the members of the Society. Taking advantage of this opportunity an extraordinary general meeting was held on Saturday, May 17. Addresses were made by H. E. Mr. Maejima, vice-president of the department of communications and vice-president of the Society, by Professor Furnichi, director of the College of Engineering of the Imperial University, and by Professor Shida, president of the council of the Society. These addresses were followed by the reading of two papers, one on "Telpherage," by Professor Shida, and the other on "Induction," by Mr. Oi, M. E., both the papers being illustrated by experimental demonstrations. An Edison phonograph of the latest type, kindly loaned for the occasion by Messrs. Frazar & Co., Edison agents for Japan, was exhibited to the members, and attracted considerable attention. A very enjoyable dinner was served in the evening at which about 150 members were present, the post of honor at the head of the table being occupied by Mr. Maejima. On the following day the members visited the works of the various electrical industries in the capital.

The Edison System of Underground Electric Tubes.

In the infancy of the electric lighting industry all wires used to convey the current from the dynamos to the lamps were placed overhead, strung usually on poles or house-top fixtures. No attempt was made to put wires carrying electric lighting currents of 200 or even 100 volts pressure underground. The promoters of the new industry doubtless profited by the experience of the builders of the first telegraph line in the attempt to place it underground, and were determined to first make the electric light a success under the most favorable conditions for good insulation. The Edison company, however, very early recognized the advantages to be gained by the ability to place the electric light wires underground whenever such a demand was made, and attacked the problem more than ten years ago. The results of the efforts of Mr. Edison and his colleagues along this line are to-day embodied in the very complete and successful system of underground tubes in extensive use in connection with the Edison system of incandescent electric lighting. This underground system is worthy of careful study, and the illustrations and descriptions of its details which are given in this connection will prove of great service to all who are interested in the distribution of electric currents for lighting and power purposes by means of underground conduits.

An electric tube, as used in the Edison system, consists of one or more conductors contained in and insulated from an iron pipe. In the Edison three-wire system, which is here described, three copper rods are placed in each pipe. The system is a sectional one, and each tube is as complete when it leaves the factory as is a rail from a rolling mill. Like a rail, it needs only to be joined to other similar units to become part of a continuous line. Unlike a conduit system, electric tubes may make as many bends as circumstances call for; while a conduit must run in a practically straight line from man-hole to man-hole.

In the three-wire system of distribution the conductors, whether overhead or underground, are divided into two classes. Feeders which run from the dynamos to centres of distribution constitute the first class. Mains radiate from centres of distribution and loop the ends of the feeders together, constituting the second class. All taps to supply customers with electric current are taken from the mains. Electric tubes are accordingly divided into feeders and mains. A main electric tube, or more briefly a main, has three insulated copper conductors of equal size. A feeder electric tube or feeder has two principal conductors and one smaller conductor to serve as a neutral wire. A feeder also has three insulated cables of seven No. 19 B. W. G. wires each. These small cables form independent circuits from the station to the point of distribution, and enable one to read in the station the electrical pressure at the outside end of the feeder. Hence these lines are called pressure wires. The system of numbering electric tubes is based on the Edison wire gauge. The size of any tube is the number of thousand circular mils in its positive or negative conductor. Thus a rod one-half inch in diameter has 250,000 circular mils area, and a tube having three such rods would be No. 250 main.

Four sizes of pipe are used in the standard tubes, and the range of sizes is given below. All pipe diameters are nominal inside measurement :

80 000	circular	mils	to	120.000	circular	mils	in	1½-inch pipe.
150,000	"	"	"	300,000	"	"	"	2 "
350,000	"	"	"	600,000	"	"	"	2½ "
700,000	"	"	"	1,000,000	"	"	"	3 "

The copper rods are all 20 feet 4 inches long, and project from each end of the pipe. All 1½-inch and 2-inch pipes are cut 20 feet long, allowing 2 inches projection of copper; 2½-inch pipes are cut 19 feet 10 inches long, giving 3 inches projection ; 3-inch pipes are cut 19 feet 9 inches long, giving 3½ inches projection of the rod. The rods are drawn to exact gauge of the finest and purest lake copper, and have a conductivity in excess of 98 per cent. The pipes are the best grade of lap welded steam pipe free from imperfections and of full weight. Fig. 1 shows sections of the standard sizes of mains and feeders. Two additional small mains, No. 67 and No. 41 are made in 1¼-inch pipe for service work only.

In making up a tube the ends of the copper rods are first chamfered and tinned. The pipe is thoroughly cleaned on the inside. Each rod is wound separately with a prepared rope, and three rods so wound are made into a triangular bundle and wound with a fourth rope. This bundle of rods bound with rope is slid into the pipe, which is afterwards filled with insulating compound. A special process insures an entire absence of air bubbles. The ends of the pipe are closed with rubber plugs. The tube is now tested by means of a delicate Thomson reflecting galvanometer, and after testing it is painted to preserve the iron from rust, and is then ready for shipment.

In order to complete the system, a means of joining the ends of the conductors in consecutive tubes, and of protecting and insulating such a joint when made is necessary. Fig. 2 shows a joint between two mains partially completed.

In Fig. 3 is shown a feeder joint partially completed. In feeder-tube joints, after the copper rods forming the main conductors are joined, the pressure wires, referred to above, are connected by soldering a wrapped splice, and then taping over the splice with insulating tape. The coupling joint which connects the rods is made of pieces of flexible cable with sockets cast on each end. These sockets are drilled to fit easily over the rods which the joint is to connect. Fig. 4 show different views of a number of sizes of coupling joints. Shorter and longer joints are made for use in turning corners, and are called elbow joints. A branch or service joint is for use where a tap is taken from a main line to supply a customer. It differs from other joints in having a socket on one end only, and a round pin-like projection at the other end of the piece of cable. This fits into the holes shown in Fig. 4 in the sides of the sockets of coupling joints. Fig. 5 shows the branch joints and link used on all service connections up to and including 120,000 circular mile area.

Having provided the joints for straight lines, bends, and branches, it is necessary to describe the means adopted for their protection and insulation. For protecting straight work an iron box made in two halves and called a coupling box is used. In Fig. 6 is shown a ball clamp which is bolted around the tube as in Figs. 2 and 3. These clamps are split collars, and grip the tube firmly. The sockets at each end of the coupling box form with the ball of the clamp a ball and socket joint. Ball clamps are made in three styles for use with 3-inch, 2½-inch, and 2-inch coupling boxes. The 2½-inch style is made in three sizes for use with 2½-inch, 2-inch, or 1½-inch pipe. The 2-inch style is made in two sizes for 2-inch and for 1½-inch pipe. A clamp for use on a pipe whose inside diameter is less than that of the largest tube used in the coupling box is called a reducing clamp. Thus a 1½-inch pipe, when used with a 2½-inch coupling box, takes a 2½-inch x 1½-inch reducing ball clamp. A 2½-inch coupling box is shown in Fig. 7. The 3-inch and 2-inch coupling boxes do not differ, except as to size. The two halves of the box are bolted together by bolts through

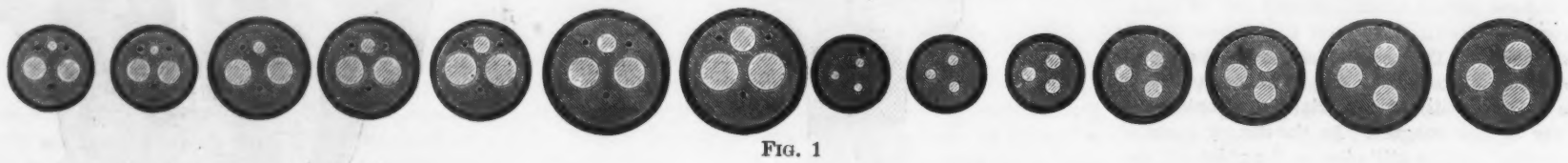


Fig. 1

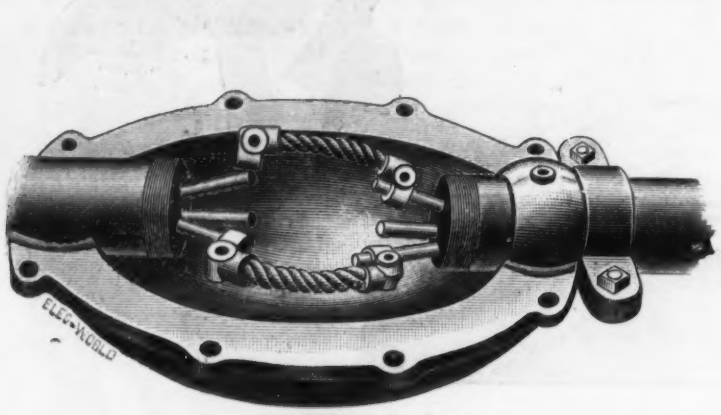


Fig. 2

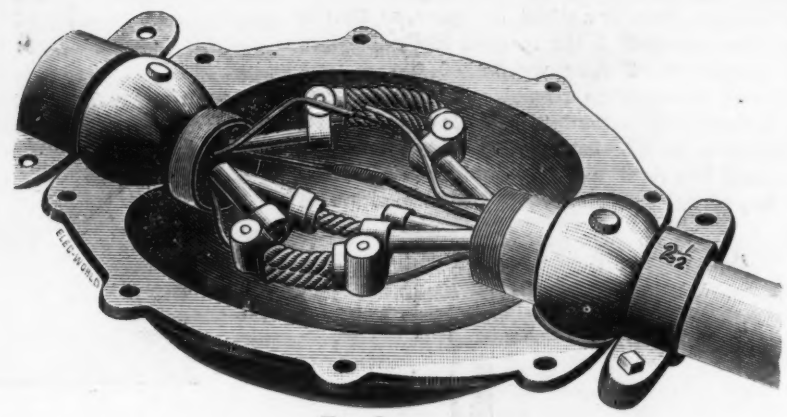


Fig. 3

Fig. 4

Fig. 5

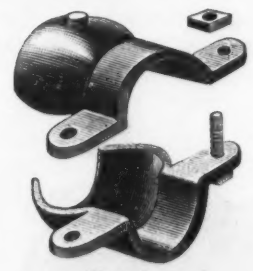
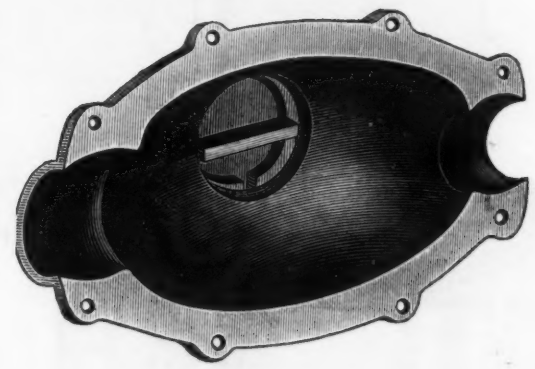


Fig. 6



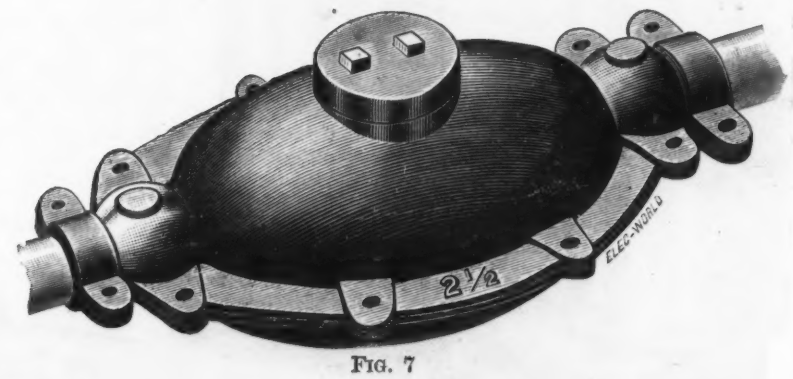


Fig. 7

EDISON UNDERGROUND TUBE SYSTEM.

the flange. In the top half is a round hole closed by a cast iron cap. Through this hole the box is filled with hot insulating compound, which surrounds and insulates the copper rods, the joints, and the tube ends. This compound does not grow brittle on cooling or with age, but remains plastic even at temperatures below the freezing point.

An elbow box 2½ inches, 90 degrees, is shown partially inclosing an elbow joint between two main tubes in Fig. 8. The 55-degree and 20-degree elbow boxes are similar in general design. All elbow boxes allow a range of 18 degrees on either side of their mean position. Thus any angle between 37 degrees and 73 degrees may be made with a 55-degree elbow box. The 3-inch elbows differ from the 2½-inch only in being larger. All elbow boxes take special clamps called cup clamps. These clamps have spherical surfaces like ball clamps, but are designed to give a greater range of movement to the ball and socket joint formed with the elbow box. The clamps for the 3 inch elbow boxes are similar to the 2½-inch cup clamp shown in Fig. 8. All boxes, whether coupling or elbow, have a round hole in the top half through which they are filled with compound. This hole is closed by a round iron cap which is locked securely in position by turning it through ¼ of a revolution. This cap makes a dirt-tight but not air-tight joint, and is called a ventilator top (see Fig. 9).

The branches, or as they are commonly called, the services to the customer's premises, are short lengths of tube which tap the main line by means of a three-way box called a tee box (see Figs. 9 and 12). These boxes are made in two styles, 2-inch tee and 2½-inch tee, which differ from the 2-inch coupling and the 2½-inch coupling only in having three nozzles instead of two. Owing to the main portion of a tee being the duplicate of a coupling of the same size any 2-inch coupling or 2½-inch coupling may be replaced by a 2-inch or 2½-inch tee without disturbing the main line. A modified form of tee called a "Y" box is used where the service makes an angle of 45 degrees with the main line. A four-way or cross-box, really a double tee, admits of two services being taken from one joint. Mains are so placed in the ground that the positive and negative conductors are on one side of a vertical plane through the centre line of the tube, while the neutral or balancing wire is on the other (see Fig. 11). The side of the tube which the neutral is on is called the inside, because the main tube is so placed that the neutral copper is nearest to the curb line. The feeders are laid symetrically, with the right hand copper as the positive conductor as the tube leaves the station. Services are never taken from feeder lines. A service to the side of the main line marked inside, and called an inside service, is shown in Fig. 12, while Fig. 9 shows a service to the opposite side called an outside service. On this basis all services are classed as either outside or inside. The same distinction is made with regard to bends in a main tube; all bends in which the neutral joint is shortened are inside elbows, while those in which the neutral joint is the longest of the three joints are called outside elbows. The table appended gives the size of service joints required for different service connections, the branch line not being larger than 120,000 circuit mils.

Size of Main Line.	Joints required for inside service.
No. 80 to No. 300	3 Short Branch Joints.
No. 350 to No. 500	3 Long Branch Joints.
	For outside service.
No. 80 to No. 500	2 Short and 1 Long Branch Joints, 1 Branch Link.

For larger services a complete tee joint is provided, which consists of the necessary main line coupling joints with the branch joints attached. The combinations of elbow joints given below cover a range of 18 degrees on each side of their mean position.

ELBOW JOINTS FOR MAIN ELBOWS.

Style Angle Box.	Joints required inside elbows.			
	Coupling.	Short.	Medium.	Long.
20°	1		2	
55°		1	2	
90°		1		2
	Joints required outside elbows.			
	Coupling.	Short.	Medium.	Long.
20°	2		1	
55°		2	1	
90°		2		1

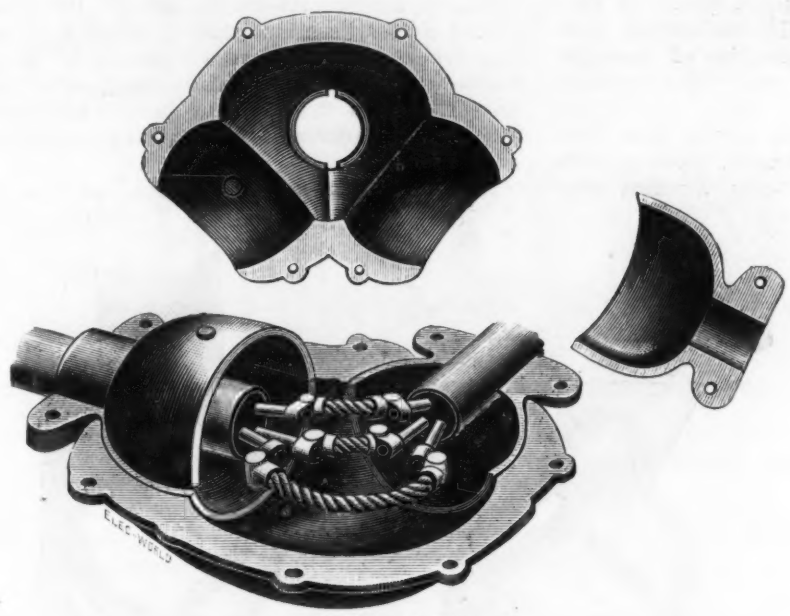


FIG. 8

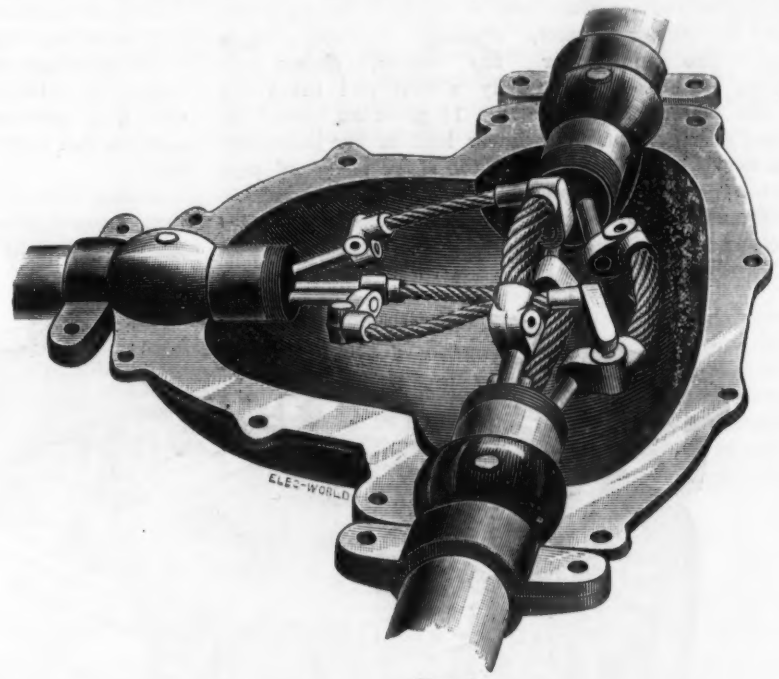


FIG. 9

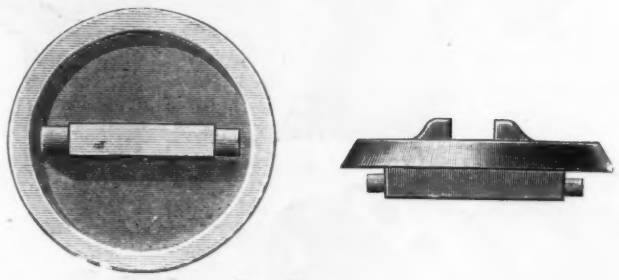


FIG. 10

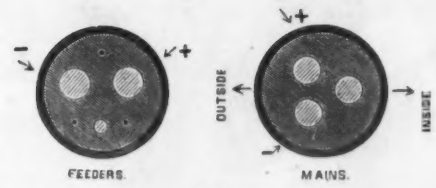


FIG. 11

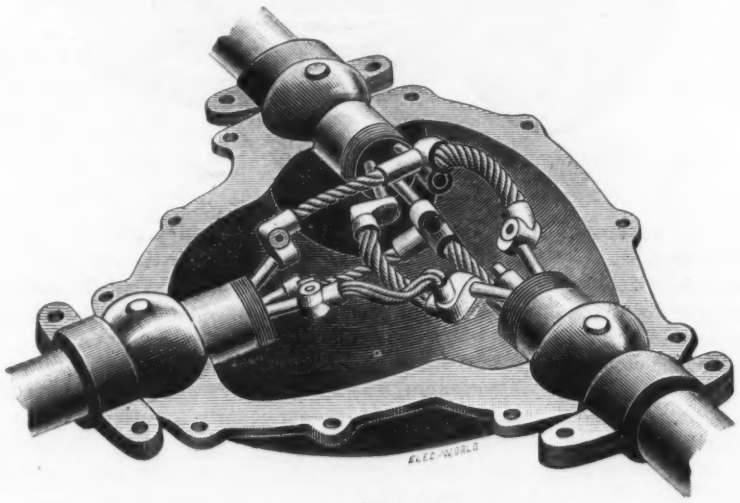


FIG. 12

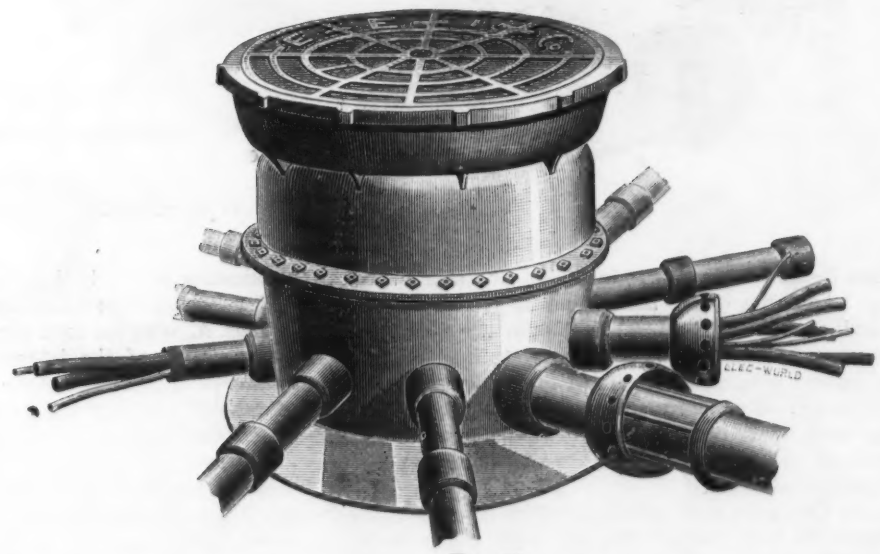


FIG. 13

EDISON UNDERGROUND SYSTEM.

ELBOW JOINTS FOR ALL FEEDER ELBOWS.

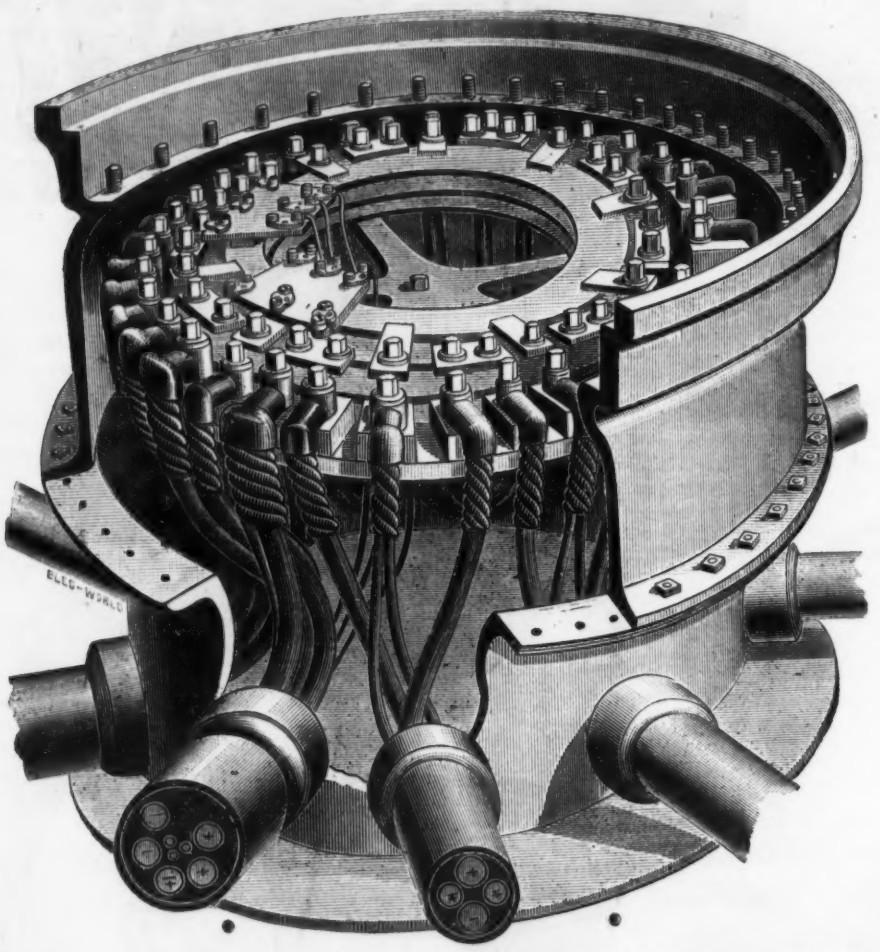
Angle Box.	Positive and Negative Coppers.				Neutral Copper.	
	Coupling.	Short.	Medium.	Long.	Medium.	Long.
20°	1		1		1	
55°		1	1		1	
90°		1		1		1

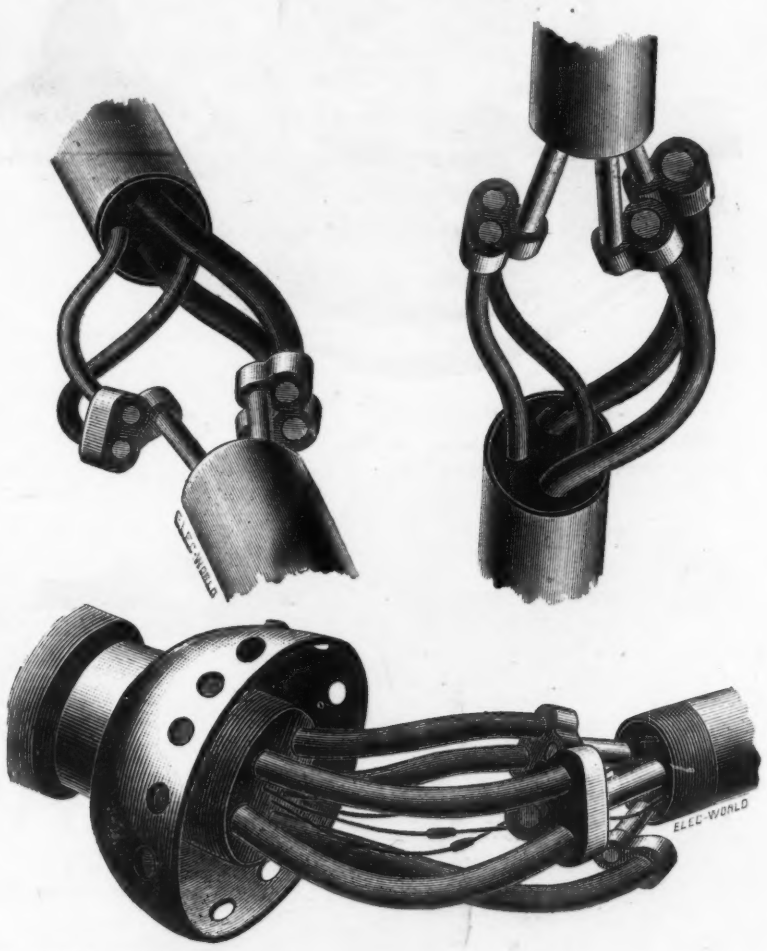
In referring to what constituted a feeder line, it was stated that it was a line from the source of current to some centre of distribution from which mains radiated. This requires that the feeder should be split up or branch out, or, what is the same thing, that it should be connected to two or more mains. The safety catch box is designed to accomplish this object. Inside of a safety catch box all wires of like polarity are connected together, thus allowing the current coming in on one or more lines to split up and supply the remaining lines from which customers obtain their current for light or power. The safety catch box serves then—first, as a centre of distribution, second, as a centre of equalization of electrical pressure between the different parts of the system. It also affords a ready

means of inspecting and testing any line, or of disconnecting a line from the system when work is to be done on it, such as the connection of services, etc. It may be noted that men thoroughly familiar with the work do not find it necessary to interrupt the current while making service connections. Fig. 13 shows a perspective view of a 10-tube safety catch box, *i. e.*, one intended for connection to ten or any less number of lines of tubes. The safety catch boxes are built in three sizes for use with four, six and ten lines respectively. A 4-tube box has four stubs, short lengths of pipe, for connection to as many lines of main tubes. A 6-tube box has four stubs for connection to mains, and two larger stubs for connection to either feeders or mains. A 10-tube safety catch box has eight stubs for connection to mains, and two for connection to either feeders or mains. The top of the box is closed by two covers, the lower of which is bolted down upon a rubber gasket, making a water-tight joint. The upper or top cover, shown in position in Fig. 13, is heavily ribbed and takes the jar and pound of traffic. Fig. 14 gives an idea of the general arrangement. The lower half of the jacket has nozzles cast on it into which the short pieces of pipe forming the stubs are screwed. The pipe used for stubs to which mains are to be connected is 2½ inches inside diameter, and all the regular 2½-inch fittings can be used with it. The feeder stubs are of 3½-inch pipe, and take a special clamp which fits elbow boxes, and is screwed and not clamped on to the stub. The cables in the stubs run to terminals which are connected by safety fuses to copper rings, having terminals opposite to all cable terminals of like polarity. The positive and negative cables in the feeder stubs are of double the size of the neutral cable, because the neutral wire is always smaller than the positive or negative conductor.

Fig. 15 illustrates the convenience of splitting the neutral conductor in main stubs. The left-hand figure shows a main with the neutral on the left hand facing the safety catch box, while the other sketch shows a right-handed neutral connected to a similar main stub. The top cable in a main stub is always connected to the positive pole of the feeder through the terminals inside the box. Fig. 16 shows a feeder jointed to the feeder stub of a safety catch box. The sockets by which a cable in a stub is connected to a rod in a tube, as shown in figs. 15 and 16, are called cable sockets. A hard rubber board secured on top of the rings and shown in Fig. 14 carries the terminals needed for the small cables running in the feeders and called pressure wires. In this way the electrical pressure at the box can be transmitted through these small cables to the station, and there measured by a suitable voltmeter enabling the attendant to maintain the pressure at the proper point under varying loads.

The system may seem burdened with details, but when it is considered that it takes the current from the dynamo and delivers it to the customer, that a tube is equivalent to three ducts in a conduit and three insulated cables, and that the system has a flexibility far ahead of any underground method of either gas or water distribution, it will be seen that it is when compared to its work exceedingly simple.





FIGS. 14-16.—EDISON UNDERGROUND TUBE SYSTEM.

The Exploration of Magnetic Fields by Means of Tubes of Rarefied Gas.*

The influence exerted by magnetic fields upon rarefied gases has from time to time received much attention. Among the many physicists who have studied the interesting phenomena which are due to such influences the following are at once suggested, namely, Plücker, De la Rive, Trève, Daniel, Le P. Secchi, Chautard, Crookes, Goldstein and Boltzmann. They have described and variously commented upon the luminous phenomena which are observed in tubes of the Geissler type, which have been placed within the influence of a magnetic field.

One of the facts upon which all observers have been fairly unanimous in their description is, that when a tube containing rarefied gas is brought within the sphere of influence of a magnet, an increase in the degree of electrical resistance is produced.

The investigations of those scientists whom we have named have been chiefly of a *qualitative* character; however, they have so added to our knowledge of these phenomena that they are now ripe for *quantitative* investigation.

Among those physicists who at the present time have been engaged in the study of this subject, Mons. A. Witz must be especially mentioned, and it is to a recent communication of his to the Academy of Science, at Paris, that we wish to direct the attention of our readers.

Mons. A. Witz has been especially devoting himself to the measurement of the intensity of the magnetic fields, the difference of potential between the electrodes of the tubes of rarefied gas and the intensity of the electric current which was made to traverse these tubes.

In these experiments a fine electro-magnet, specially made by Ducretet, was used, of such a strength that it was possible to obtain with it a magnetic field of from 100 to 14,000 units.

The intensity was determined by observing the rotation of the plane of polarization in carbon bisulphide. Between the poles of the magnet were placed either Geissler tubes or a cylindrical tube of 20 millimeters diameter, having movable electrodes such that it was possible to vary their distance and also the pressure of the gas within it; the tube experimented upon was excited with a Rhumkorf coil. Into the induced circuit a galvanometer was introduced which had to be placed at a distance of nearly 35 millimeters from the electro-magnet in order that the latter might exercise no appreciable influence over it. The intensity of the induced current, which was always full, was estimated in milliampères.

In order to estimate the difference of potential between the electrodes of the tube, a sparking micrometer was employed; when the sparks were passing continuously at the same time in the tube and in this micrometer, it was assumed that the differences of potential were equal. It will at once be recognized that this method is really an adaptation of one originally employed by Faraday, and applied by Schultz to the study of the electrification of tubes containing rarefied gas.

While measuring simultaneously the intensity of the magnetic field and that of the difference of potential between the two electrodes, Mons. Witz arrived at the conclusion that this difference of potential increases with the intensity of the magnetic field; but for a given field and tube the difference is independent of the intensity of the discharge.

In order to demonstrate this, the following are some specimen figures extracted from Mons. Witz's laboratory note book; they refer to a tube containing air situated in a uniform magnetic field influencing almost its entire length:

	Intensity.		
	Of the field in C. G. S. units.	Of the current in milliampères.	Difference of potential in volts.
(*a*)	0	4.12	1,860
(*b*)	2,200	2 58	2,781
(*c*)	3,200	2.39	4,146
(*d*)	4,300	2.20	5,064

In these experiments the intensity of the "inducing" current remained constant, and the influence of the magnetic field created, as it were, a resistance to the flow of the electricity. To maintain the intensity of the "induced" current constant it sufficed to increase the "inducing" current, and the difference of potential was not perceptibly raised.

This phenomenon is exhibited in the case of each of the ordinary gases, but, as might be supposed, to a variable extent. It appears to be most marked in the case of those gases, of which the spectrum is most modified whilst under the influence of the magnetic field. And it varies with the conditions of the tube.

If the experiment be carried on between circular poles of 20 millimetres diameter, it can be proved that different points of the tube are not equally sensitive, so that in exhibiting the effects obtained with a tube containing bromine vapor it is desirable to cause the tube to move between the poles.

The following are typical results:

Field.		Intensity of current.	Difference of potential.
		Milliampères.	Volts.
0 C. G. S. units		6.58	1,325
11,570 units	on the positive pole	2.97	4,464
	beginning of the capillary	2.62	4,964
	middle	3.35	3,780
	end	2.80	4,935
	on the negative pole	2.25	3,066

The maximum effect is produced at the ends of the capillary tube on the same side as the positive pole; it is greater at the positive pole than at the negative pole.

The same has been observed for fluoride of silica, but the action is the reverse in the case of air.

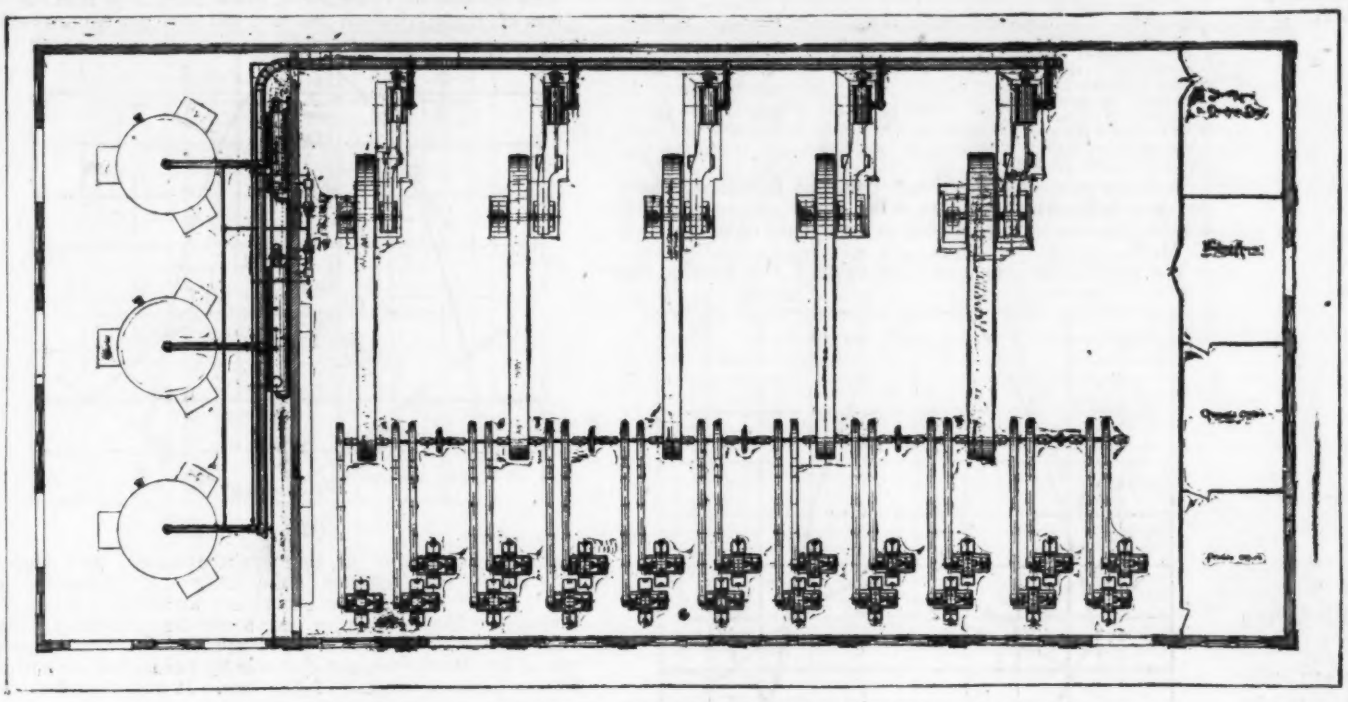
Whatever the position of the tube in the field may be, it is always observed that the current is displaced according to the laws of electro-magnetism. The tube being arranged so that it cuts across the lines of force the luminous thread which traces the course of the current is thrown to one side. When the tube is placed, as it were, parallel to the lines of force the luminous thread proceeds in a straight line from one electrode to the other. If the tube be laid upon one of the poles of the magnet the luminous

*From the London *Electrical Review*.

thread appears to have the form of an S, being turned toward the right by one pole and toward the left by the other—phenomena which might be foreseen from what has already been stated.

Mons. Witz noticed one exceedingly curious phenomenon which appears to be quite new, and which can be taken advantage of with good results in the exploration of the magnetic field. When the tube is carried into the magnetic field, it is observed that the appearance of its poles changes according to the intensity of that part of the field which it then occupied. A bluish disc appears, which changes its position and appearance as the tube is moved about in the field in such a way that the direction of the lines of force in the field become actually visible to the eye. This phenomenon must be seen before it can be properly appreciated, and, without having it to appeal to, it becomes a matter of great difficulty to give any intelligent verbal description of it.

This phenomenon is shown with great brilliancy if small tubes filled either with chlorine, bromine vapor, hydrogen, or fluoride of silica are employed, and Mons. Witz states that it can be used with great accuracy in the exploration of intense magnetic fields.



INDIANAPOLIS ELECTRIC RAILWAY POWER STATION—PLAN.

The Indianapolis Railway Power Station.

The accompanying cuts show the ground plan and elevation of the power station of the Citizens Street Railway Company at Indianapolis, Ind. The building is of sufficient capacity to contain 23 Thomson-Houston railway generators, and at the same time afford room for offices and a general machine shop.

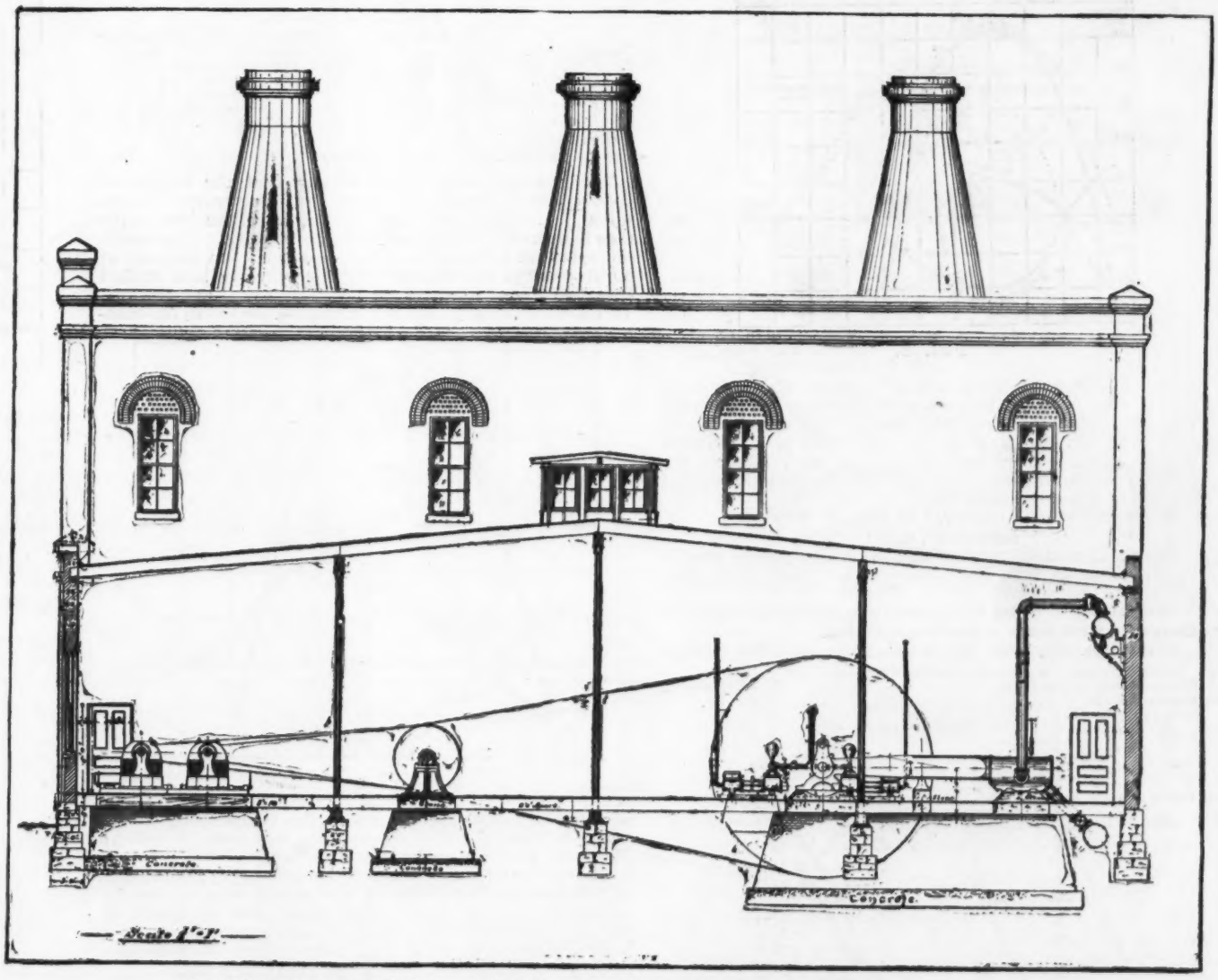
The boiler plant consists of 3 Hazelton boilers, fitted to burn natural gas, and also arranged with furnaces to burn coal, as shown by the three extensions to each boiler on the plan. The gas burners in each boiler are located in such a manner that they do not interfere in the slightest with the coal furnaces, it being possible to make a change from gas to coal at a moment's notice. This is a very great advantage over the ordinary practice, as it is customary to place these burners on the grates, which, in case it was desired to use coal, would have to be removed—not an easy task.

The engines are so arranged and connected that any number can be run at the same time, and any one can be started and stopped while the rest of the plant is in operation. The shafting is made of the best quality of hammered steel, and is supported by ball and socket self-oiling bearings. This is the first system that has been equipped upon this plan, and it is highly satisfactory. The steam piping for this plant is of ample capacity and so arranged that when the whole plant is in operation every detail will be of proper size and proportion.

The feed water for the boilers is first passed through a Hoppes purifier, which removes the impurities and heats the water at the same time up to boiling point. From this heater the water is pumped by Barr duplex pumps into the boilers. Everything about the feed water system is arranged in duplicate, so that in case of accidental injury operations would in no way be interfered with.

The general arrangement of this installation is shown by the cut representing a section across the engine and dynamo room. The entire installation rests upon masonry, consisting of a concrete base with the brickwork on top laid in cement, and everything about the plant is constructed in the most substantial manner possible, and its operation is ample proof of the thorough workmanship and good material employed.

The engine which has just been put in operation, was built by the Wheelock Company, of Worcester, Mass. The entire installation was planned and erected by Mr. L. H. McIntire, of the railway engineering department of the Thomson-Houston Electric Company. The work of installing the plant was in charge of Mr. W. S. Twining.



INDIANAPOLIS ELECTRIC RAILWAY POWER STATION—SECTIONAL ELEVATION.

The New Electric Light Station at Halifax, N. S.

The growth of the electric lighting and power business in Halifax has made necessary the erection of a new plant by the Halifax Illuminating and Power Company, which is now completed and was thrown open for the inspection of the public Monday evening, June 16. About 200 people, including the members of the city council, availed themselves of this opportunity of examining the new electrical equipment.

The station is a substantial two-story brick building. The boiler room is about 40 feet square and the engine and dynamo room is 40 × 50 feet. The boiler room is furnished with four tubular boilers six feet in diameter and 16 feet in length, made of half-inch steel and so constructed as to stand a pressure of at least 120 pounds to the square inch. Each boiler connects from the top by an 8-inch steam pipe with a 12-inch pipe running the whole length of the engine room, about 3 feet from the second floor.

In the engine room are set four compound engines, one of the Armington & Sims and three of the McIntosh & Seymour type. These engines were all made to order and specially designed in all their running parts for the work of this company. The dynamos are belted direct from the fly wheels of the engines. The engines are all high speed and are run at the rate of about 260 revolutions per minute. Their united capacity aggregates about 600 h. p. The engines exhaust into large pipes running also beneath the floor, which in turn carry the exhaust steam either into a large surface condenser or, at the will of the engineer, by another pipe through the roof into the open air.

The electrical plant consists of seven new arc dynamos each of a capacity of 50 lights, of 2,000 c. p., and two incandescent alternating dynamos, of a united capacity of 3,650 16 c. p. lights. The switchboard covers an area of about 30 × 12 feet, is made of black walnut and cherry, and was designed by the superintendent, Mr. R. A. Cogswell.

The second story is divided off by pine partitions into a repairing and testing room, two lamp rooms, a reading room, a bed-room, a wire store room, and an office for the superintendent. The company's staff of employés at present numbers 25. The business is growing so rapidly that already an increase in the size of the station is contemplated. Increased facilities for furnishing lights have in turn created a greater demand, and the present prospects are that the new station will soon be taxed to its utmost capacity to supply the lights called for.

Underground Photography.

An interesting application of electricity was recently made in France, a photograph being taken under difficult conditions. According to the London *Electrical Engineer* a landslide occurred at a quarry, and a large number of workmen were buried in the subterranean gallery. It was supposed that the men were entombed in one of the galleries about 220 ft. below the mouth of the mine; but nothing certain was known of their position, and for an attempt at a rescue to have any chance of success an approximate idea of their whereabouts had to be gained. The difficulty was surmounted by sinking a shaft about a foot in diameter, in the direction of the gallery, and through it, lowering, by means of a chain, a small camera, mounted in a metallic tube. The camera was pivoted within the tube at its upper end, so that it might be fixed at any angle by tightening or slackening the connecting cord. Above and below the camera were placed rows of incandescent lamps, and when the apparatus had been lowered, the camera was made to incline outward from the case. The current was turned on, the plate exposed, and the photograph taken.

Some Experiments Upon Alternating Current Apparatus.*

BY HARRIS J. RYAN.

It is well known that when the core of a transformer is heated under certain favorable conditions, the secondary will deliver electrical energy in amount considerably greater than when the core is not heated, and that this is done, too, without an increase of the energy that is supplied to the primary. In fact, we are told that on heating the core of the properly constructed transformer there

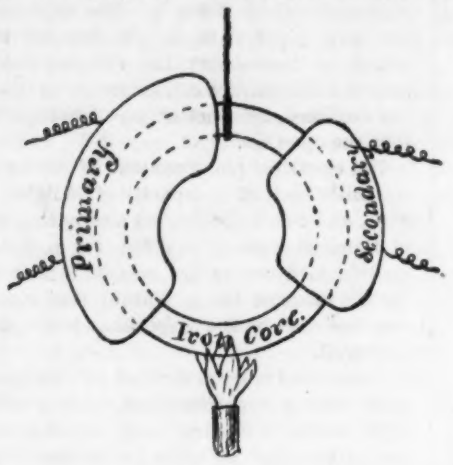


FIG. 1.

will be obtained a diminution of energy taken up by the primary and a considerable increase in that given out by the secondary.

In some recent experiments made in the Physical Laboratory of Cornell University, it was not possible to obtain the above effect. Mr. L. B. Marks, a student in electrical engineering at Cornell, made an apparatus that differed materially from the forms that were first made use of in which he found this phenomenon very marked.

For two reasons do we think that the details of the performance of Mr. Marks' apparatus will be of interest to the members of the Institute. First, that they indicate clearly the source of energy in the phenomenon observed with his apparatus, and second, that they show in exaggerated form certain phenomena that must be done away with in a transformer that is to be used for incandescent lighting.

A good idea of the apparatus will be obtained through a glance at Fig. 1. The core consisted of nine well-rusted

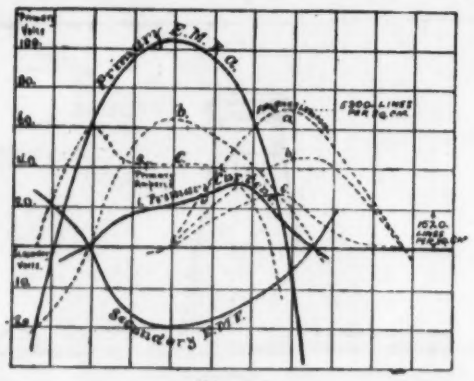


FIG. 2.

rings 1.1 centimetres thick and of a mean diameter of 17 centimetres each. The number of turns on the primary was 500, on the secondary 155. Size of bare copper wire in each was No. 18, B. & S. G. The wire was insulated with asbestos paper, and because of its thickness the primary and secondary turns with their insulation occupied a space of abnormal proportions.

Resistance of the primary, 1.65 ohms.
" " " secondary, 0.71 "

The maximum magnetization used in the core in any of the experiments here described was not above 3,000 lines per square centimetre.

Diagrams 2, 4, 5 and 6 represent graphically the observations that were made with the apparatus.

From these diagrams are deduced the following results:

Secondary open, no extraneous heat applied:
Temperature of the core ..... 97.5 degrees C.
Primary E. M. F. ..... 75.6 volts.
Secondary E. M. F. ..... 16.4 "
Ratio, $\frac{75.6}{16.4}$ 4.6
Secondary current 0.0

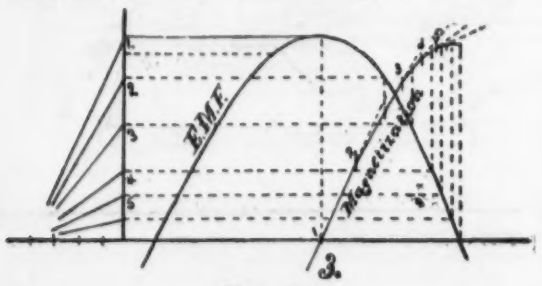


FIG. 3.

Secondary open, core heated:
Temperature of core ..... 300.0 degrees C.
Primary E. M. F. ..... 99.4 volts.
Secondary E. M. F. ..... 24.5 "
Ratio, $\frac{99.4}{24.5}$ ..... 4.
Secondary current 0.0

Secondary closed, no heat applied.
Temperature of the core ..... 100.0 degrees C.
Primary E. M. F. ..... 89.3 volts.
Secondary E. M. F. ..... 11.9 "
Ratio, $\frac{89.3}{11.9}$ 8.1
Secondary current ..... 2.0 ampères.

* Read before the American Institute of Electrical Engineers, New York, June 17, 1890.

Secondary closed, core heated.
Tempera ure of core ..... 270.0 degrees C.
Primary E. M. F ..... 95.7 volts.
Secondary E. M. F. ..... 13.4 "
Ratio, $\frac{95.7}{13.4}$ 7.1
Secondary current 2.4

TABLE I.

	Temperature.	Primary E. M. F.	Primary watts.	Secondary watts.
2. Secondary open, no heat applied to core	97.5° C.	75 6	87.	0.0
4. Secondary open, heat applied to core	300. ° C.	99.4	88.	0.0
5. Secondary closed, no heat applied to core	100. ° C.	89.3	13.9	24.
6. Secondary closed, heat applied to core	270. ° C.	95.7	12.9	36.7

Data are presented in the latter part of this paper, showing that it is correct to assume for small ranges that the loss in the core is proportional to the square of the primary E. M. F.

We can therefore deduce from table I the results that

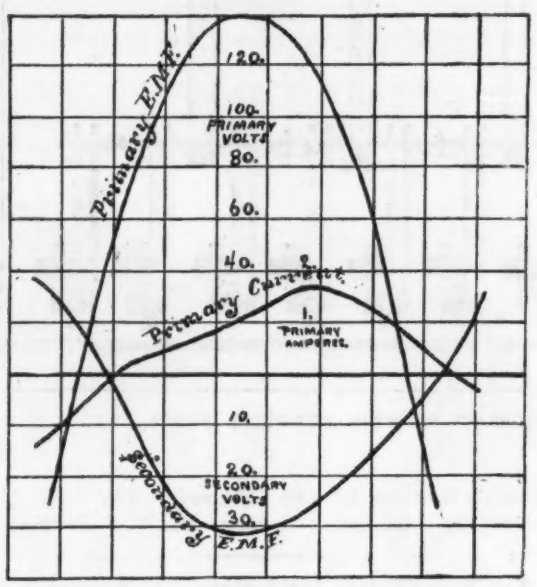


FIG. 4.

would have been obtained with 90 volts as the primary E. M. F. for the four experiments:

TABLE II.
Primary, 90 volts—120.

Temperature.	Loss in core.	Primary watts.	Secondary watts.
2. 97.5° C.	122.	122.	0.0
4. 300. ° C.	72.	72.	0.0
270. ° C.	79.*	79.	0.0
5. 99. ° C.	117.	131	24. †
6. 270. ° C.	80.	116.7	36.7†

*Estimated.
†Corrected for resistance of secondary.

The figures in table II show clearly that the loss in the core is greatly diminished when its temperature is elevated, *i. e.* when heat is applied, and that the loss in the core is practically independent of the output. The results indicate that with the secondary open and the primary at a difference of potential of 90 volts without heat applied the core came to a temperature of 97 degrees C. and dissipated 122 watts, then by the application of heat with the Bun-

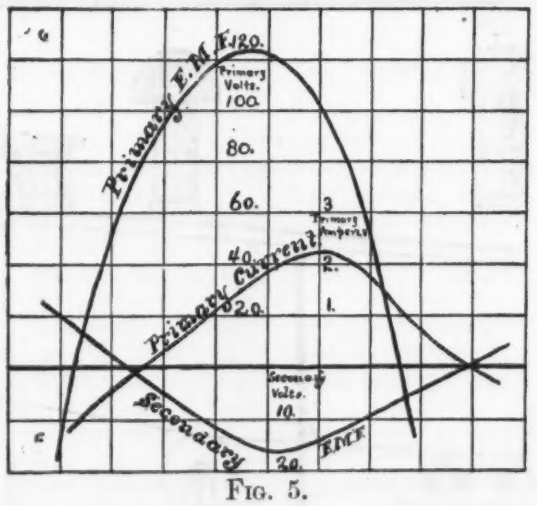


FIG. 5.

sen burner, as indicated in Fig. 1, the temperature of the core was raised to 300 degrees C. and was found to take up 72 watts. Now if we assume the change in watts dissipated in the core to be approximately proportional to the changes in temperature that produced the same, then we see by estimation that 79 watts would have been dissipated by the core at 270 degrees C., while 80 watts were found to have been dissipated by it at that temperature when the secondary was closed and gave an output of 32 watts.

It is perfectly plain, therefore, why we can close the secondary, take from it 32 watts, elevate the temperature of the core 107 degrees C. and have the primary take up 5 watts less than when the secondary was open, and the core at the lower temperature.

Since the effect is due only to the fact that the core takes much less energy at higher than at lower temperatures, and since the core can dissipate energy through *Foucault current* and *hysteresis* phenomena only, it is due to a decrease of the total energy dissipated through changes in the above phenomena.

A rise of temperature in the core will increase its specific resistance, and therefore diminish the energy dissipated by Foucault currents. For decided degrees of magnetization it is known that the permeability of iron increases when it undergoes a rise of temperature. It was thought probable, therefore, that the energy dissipated per cycle of magnetization and demagnetization would be decreased with an increase of temperature

Experiments were made in the Physical Laboratory of Cornell University by Mr. Arthur Herschel on the hysteresis at high temperatures of a cast iron ring, 12.3 centimetres in diameter, that furnished a closed magnetic circuit the length of which was 38.5 centimetres. The ring was wound with 80 turns of No. 8 wire cable that had a mica insulation.

The highest temperature to which the ring was subjected was 360 degrees C.

The results of these experiments are represented graphically in Fig. 7.

One interesting thing about these results is that for degrees of magnetization below 2,000 lines per square centi-

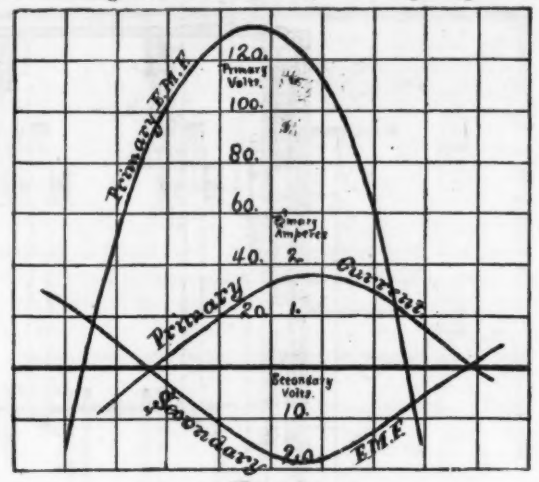


FIG. 6.

metre the variation of temperature below 360 degrees C. does not change the magnetic character of the iron by an observable amount. Now, if wrought iron behaves in a similar manner, then the decrease of energy dissipated in the apparatus of Mr. Marks was not due wholly nor in part to a diminution in the hysteresis of the iron. It was therefore due

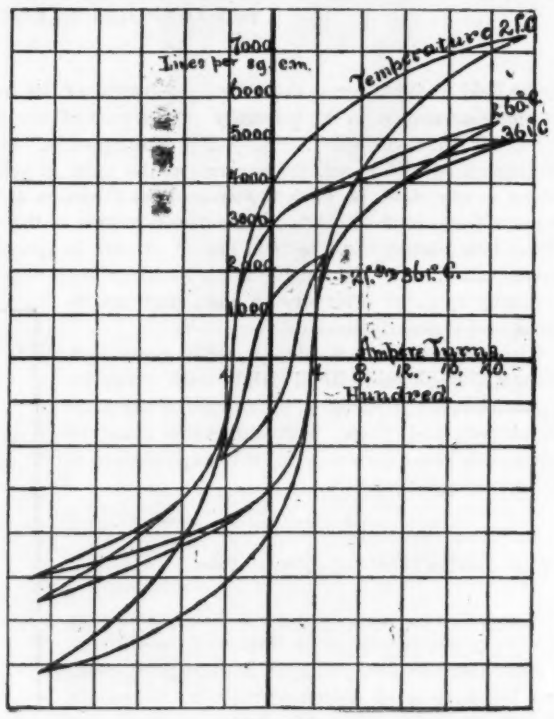


FIG. 7.

entirely to diminution in Foucault currents, caused by the change of the resistance of the iron. A liberal estimate for the hysteresis of the core is twenty watts, whence the Foucault energy dissipated by the core at 100 degrees C. and 90 volts was 102 watts, and at 270 degrees C. and 90 volts it was 60 watts.

The range of temperature that produced this change was 170°. The magnetization for each condition is the same,

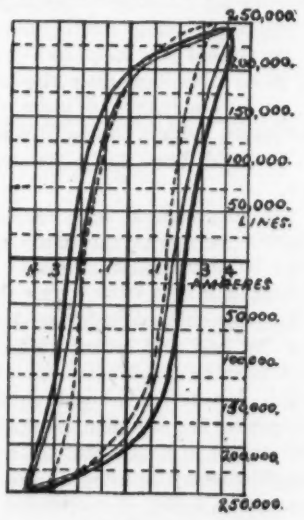


FIG. 8.

so that it is fair to assume that the E. M. F. setting up the Foucault currents is the same and that therefore the energy dissipated by Foucault currents will diminish as the resistance of the iron is increased by the elevation of its temperature.

This gives us a rough determination for the temperature coefficient of the iron to be 4 of one per cent. per degree centigrade, which agrees with Matthiessen's determination and furnishes a fair check upon the conclusion just arrived at.

The second interesting feature about the performance of Mr. Marks' apparatus lies in the fact that the ratio of primary to secondary turns was 3.2, while the ratio of primary to secondary E. M. F.'s varied from 4 to 8. In this it ex-

hibited exceedingly bad regulation, so that by examination of the diagrams 2, 4, 5 and 6 we can see in exaggerated form the trouble it is so hard to become rid of in transformers to be used for incandescent lighting. Any one of these diagrams shows that a large portion of the lines of magnetization that were set up about the primary were not set up about the secondary. That is to say, the counter E. M. F. that is produced in the primary is due to the magnetization through it that also took place through the

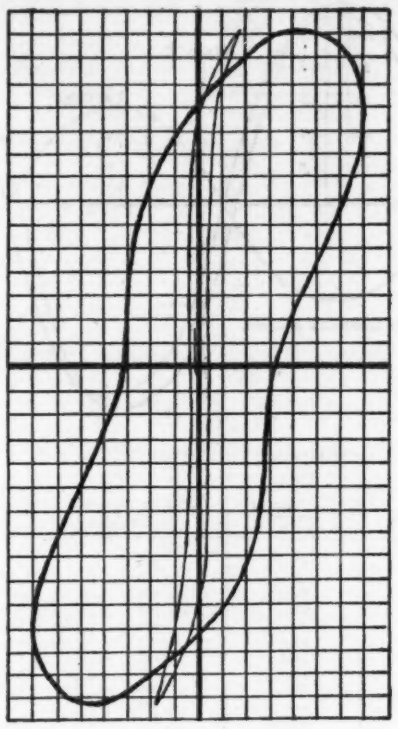


FIG. 9

secondary plus the variation of magnetization that was set up in its own air space and that leaked by the secondary through the air. When the transformer furnishes current this difference becomes greater and greater because of the increased current in the primary and the setting up of a counter magnetization by the secondary current in its own air space that still further reduces the magnetization through it.

Fig. 1 shows the primary disposed on one side and the secondary on the other side of the annular core. The insulation was produced by thick asbestos paper that produced large air spaces between the turns in which magnetization was produced.

In Fig. 2 E. M. F. curve *b* is the counter E. M. F. in the primary produced by the magnetization through it that

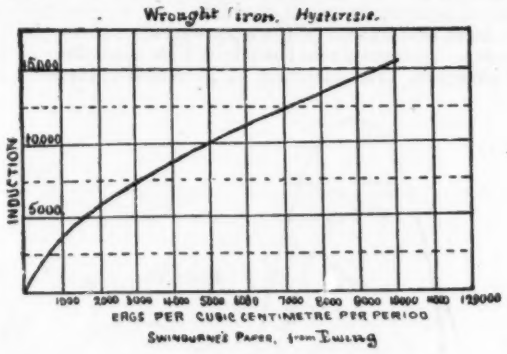


FIG. 10.

also took place through the secondary, and which is obtained by multiplying the secondary E. M. F. by 3.2, the ratio of the turns. E. M. F. *c* is the curve of counter E. M. F. in the primary that was produced by magnetization through the primary that did not take place through the secondary. This is obtained by substracting E. M. F. *b*. from E. M. F. *a*. E. M. F. c is seen to be approximately proportional to the rate of change of the primary current which suggests magnetization that is set up through the primary that is proportional to the primary current, or that which is set up in the air, or in a magnetic circuit compounded of iron and air.

In the same figure the curves of magnetization *a* and *b*

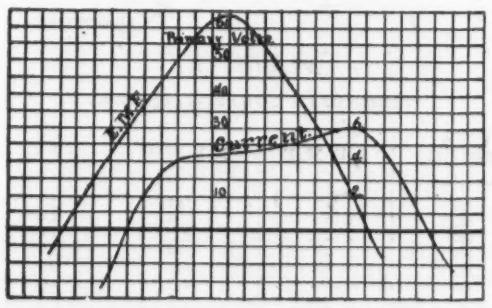


FIG. 11.

are obtained graphically from the curves of E. M. F. *a* and *b* by the method shown in Fig. 3.

This method is found to be fully as accurate, and requires much less time and is more simplified than the analytic method making use of Fourier's theorem. By substracting *b* from *a* we obtain *c*, the curve of magnetization that was produced through the primary and not through the secondary. This curve of magnetization *c* is seen by the diagram to be of about the same form as the current curve, but to lag behind the latter, which indicates that it was magnetization that was produced through air and air and iron.

During the discussion at a recent meeting of the Institute, the question was asked whether measurements of Foucault currents and hysteresis as separated from each other had ever been made.

There can be no doubt but that we do have separate determinations of those quantities when we have determined the energy dissipated in a magnetic circuit of iron by rapid cycles of magnetization and demagnetization and the energy dissipated by static hysteresis for the same rapidity and degree of magnetic changes as determined from a Ewing card observed through slow magnetization and demagnetization.

Diagrams 8 and 9 are two good illustrations of such determinations.

In diagram 8 the outer card represents the card obtained from the existing current and magnetization curves taken at 138 reverse from the 10-light transformer upon which the tests were made that were communicated to the Institute by the writer at the last December meeting. The inner card drawn in a full line in Fig. 8 is the Ewing card of static hysteresis. This transformer on being taken apart was found to have its discs insulated with paper so that the statement made by the writer in December with regard to the lamination of the transformer was erroneous in this particular. Foucault currents should, therefore, be found to be quite absent as the diagram in Fig. 8 indicates. A study of these cards does not reveal that which can be recognized as a trace of viscous hysteresis, and they differ only by an amount of Foucault current energy that is represented by a small current lagging approximately an eighth of a period behind the primary impressed E. M. F.

In Fig. 9 the outer card is deducted from the current and magnetization curves that are represented in diagram 12.

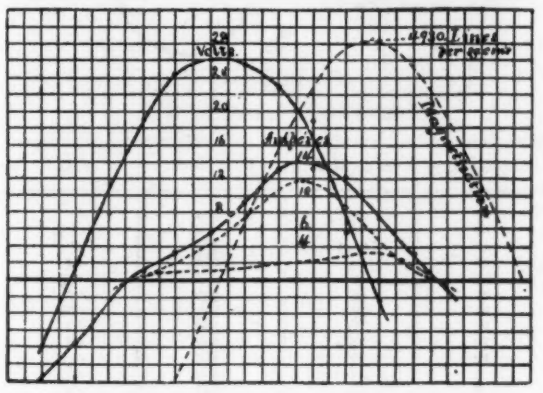


FIG. 12.

These curves were obtained with 195 reversals per second from a cast iron ring 8.6 centimetres in diameter, and 2.7 square centimetres in cross section, wound with 200 turns of wire that had a negligible resistance.

In Fig 9 the inner card is the card of static hysteresis.

In diagram 12 the lower broken current curve is that of the exciting curve drawn in from the inner card of Fig. 9. By substracting this current from the one that was ob-

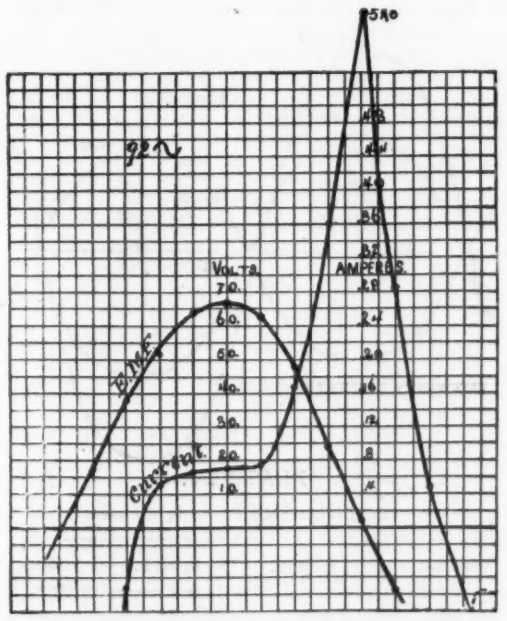


FIG. 13.

served we obtain the upper broken current curve, which is the current that exists to supply the Foucault current energy in the core. The point to be noticed from the two extreme cases here taken up is that in each case the curve of current supplying the Foucault current energy is about one-eighth of a period behind the impressed E. M. F.

TABLE 4.

	Coil of wire, B. & S. G.	Area of coil sq. cms.	Periodicity.	Magnetization per sq. cm.	Loss watts per cu. cm.
1 ..	12	5	169	5300	.18
2 ..	12	5	177	8560	.46
3 ..	12	5	177	11130	.75
4 ..	16	4.9	173	6000	.14
5 ..	16	4.9	175	9430	.33
6 ..	16	4.9	167	10930	.43
7 ..	16	4.9	93	7250	.10
8 ..	16	4.9	92	13360	.41
9 ..	16	4.9	45	13000	.10
10..	24	3.56	175	8150	.19
11..	24	3.56	53	8760	.12
12..	36	3.14	173	9200	.16
13..	36	3.14	173	14900	.29
14..	36	3.14	173	18000 app.	.48
15..	36	3.14	96	10700	.15
16..	36	3.14	92	17800	.33
17..	36*	3.14	47	18000 app.	.13
18..	36	2 7	160	4920	1.50

*Cast iron diam., 3 5 × 2.54.

Messrs. Fortenbaugh and Sawyer, students in electrical engineering at Cornell University, made determinations, the results of which are given in table 4, of the amounts of energy that are taken up per cubic centimeter in wrought wire cores, of different degrees of lamination, at various degrees of magnetization, and at different periodicities in which the oxidized surface of the iron was depended upon for insulation. They made use of four iron wire rings the mean diameter of which was 8.9 centimeters and on each of which were wound 200 turns of wire that had a negligible resistance.

Diagrams 11 and 13 are given for illustrating the extreme variation in the character of the exciting current in going from the lowest to the highest degree of magnetization.

The results show on account of the presence of Foucault currents to a larger extent for the higher degrees of magnetization a variation in losses as the square of the periodicity and the square of the magnetization. The results obtained with the several cores at the periodicity of 175 have been plotted in diagram 14.

The core of No. 36 wire agrees closely with Ewing's determination of static hysteresis for moderately soft wrought iron, and is therefore entirely free from Foucault currents. It is interesting to note that for the cores of Nos. 36, 24

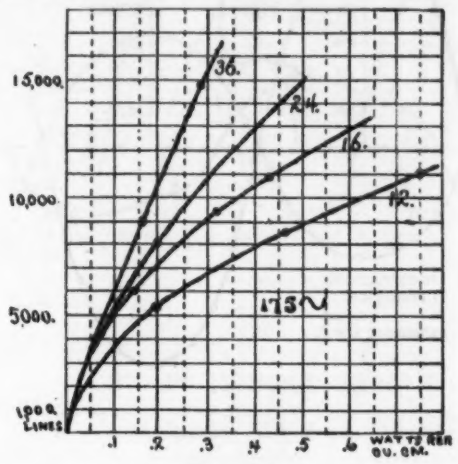


FIG. 14.

and 16 there is but little difference in the losses for degrees of magnetization below 4,000 lines per centimetre.

Likewise that for the higher degrees of magnetization it is seen that the loss is proportional to the magnetization, as Ewing's results on static hysteresis given in Fig. 10 indicate they should be.

Diagram 13 shows the effect of compelling the magnetization to be carried above the bend of the characteristic curve of the iron.

Efficiency of the Transformer.*

BY CALVIN HUMPHREY AND WILLIAM H. POWELL.

In pursuing this particular line of investigation it has been our endeavor to throw some light, if possible, upon the general subject of transformers, and upon the action

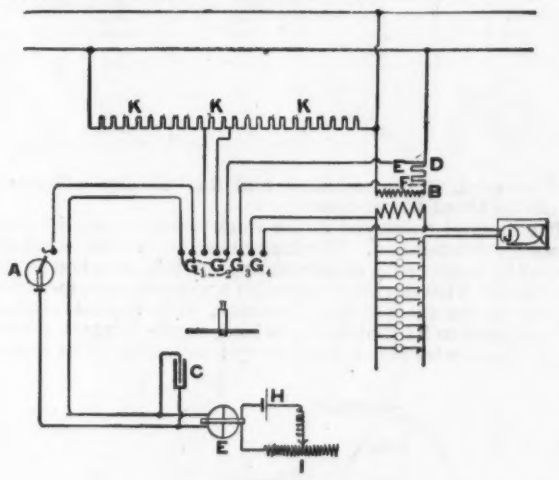


FIG. 1.

of iron when magnetized and demagnetized by an alternating current of high periodicity. And in order that the results obtained might have a practical bearing, the conditions of working were made to conform as closely as possible to the conditions under which the transformer systems are operated in this country.

The question of the economy of the commercial converter as a transformer of energy has been frequently taken up, both from practical and theoretical standpoints, but with widely varying and conflicting results. The losses in the transformer of the closed circuit type have

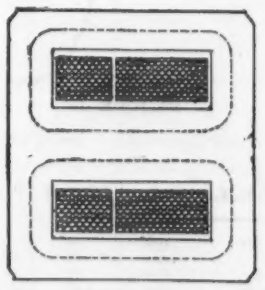


FIG. 2.

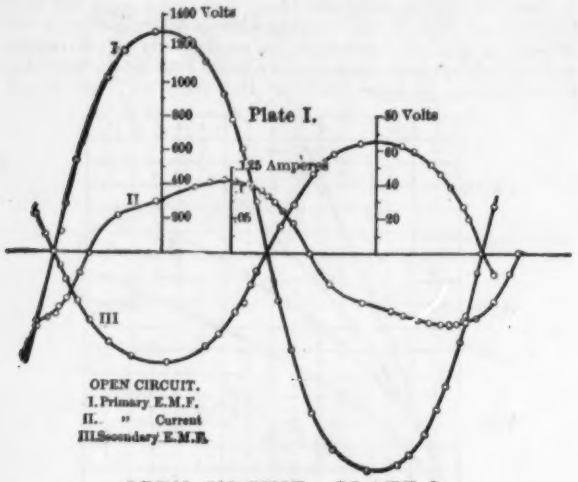
been considered large and inevitable, so much so in fact that Mr. Swinburne has introduced in England a new form of open circuit transformer known as the "Hedgehog." It has been Mr. Swinburne's endeavor to obviate the dissipation of energy in hysteresis and Foucault currents in a part of the magnetic circuit by having that circuit closed through air. But as will be seen later, the perfection of the transformer is to be met in a better grade of iron, rather than in any radical change in design.

The results presented in this paper are of especial interest as being supplementary to the work of Professor Ryan and Mr. Merritt in the same line, presented to the Institute last December. The 10-light transformer which they tested was found to have a remarkably heavy loss on open circuit, which was shown to be due almost entirely to hysteresis in the iron. The transformer gave an efficiency of 86 per

*Read before the American Institute of Electrical Engineers, New York, June 17, 1890.

cent. at normal load and an "all-day" efficiency of about 40 per cent.

In our work on a 40-light transformer of the same design (the two coils placed side by side in a core of laminated plates, see Fig. 2), but of more recent manufacture, the loss on open circuit was found to be about one-half as great as in the 10-light transformer. Its efficiency reached



OPEN CIRCUIT, PLATE I.

BRUSH.	S. E. M. F.	P. E. M. F.	P. C.
18.5	21. Volts.	450 Volts.	.104 Amperes.
18.2	9.	190	.102
18.	0.	0	.096
17.8	9.	100	.084
17.6	16.5	310	.074
17.3	28.	545	.036
17.	39.	760	.0±
16.5	51.5	1020	.0±
16.	59.	1170	.056
15.	65.	1285	.074
14.	61.5	1223	.094
13.5	57.	1130	.102
13.	47.	925	.104
12.7	40.	780	.104
12.4	27.5	565	.102
12.2	20.	330	.098
12.	9.	245	.096
11.8	0.±	70	.088
11.6	0.±	0	.078
11.3	14.	300	.056
11.	27.5	560	.046
10.5	44.	890	0
10.	56.	1105	.03
9.	63.5	1265	.072
8.	63.5	1285	.09
7.5	60 5	1215	.098
7.	53.5	1085	.104
6.7	47.5	945	.110
6.4	40.	810	.110
6.2	29.	610	.108
6.	26.	545	.106
5.8	18.	385	.104
5.5	0 +	110	.098
5.	14.	260	.074

96.2 per cent. at normal load, and the "all-day" efficiency would be about 90 per cent.

The method employed in the work is substantially Professor Ryan's method. The instantaneous values were obtained by means of a commutating device, attached to the alternater. This device consisted of a wooden disc, mounted rigidly on the shaft of the alternater, with a steel contact at one point in its periphery, which made contact with a small piano wire brush once every revolution. The holder

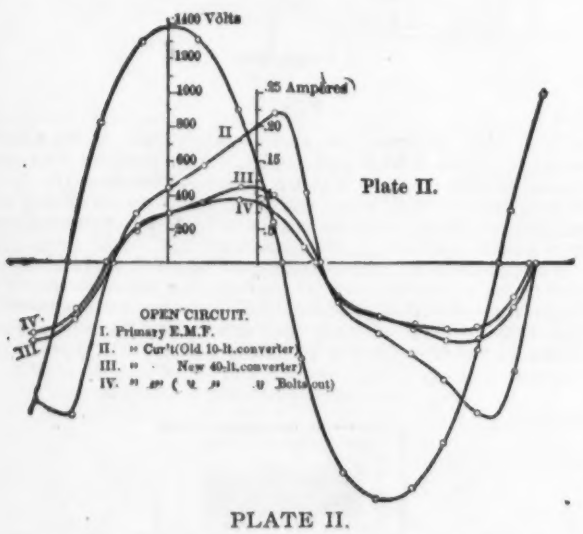


PLATE II.

Open Circuit (Old 10-lt Converter.) (40-lt Converter. Bolts Out.)

BRUSH.	P. E. M. F.	P. C.	BRUSH.	P. E. M. F.	P. C.
19	825	.196	19	775	.098
18	0	.225	18	0	.089
17	840	.042	17	845	.0
16	1320	.075	16	1245	.048
15	1420	.117	15	1355	.074
14	1345	.143	14	1290	.09
13	1010	.18	13	965	.09
12	230	.22	12	235	.074
11	630	.1	11	590	.0
10	1115	.058	10	1140	.043
9	1395	.1	9	1325	.074
8	1420	.13	8	1312	.09
7	1195	.17	7	1103	.1
6	570	.217	6	520	.1
5	300	.18	5	318	.058
4	1060	0	4	1014	0

carrying the piano wire brush was attached to a second disc carrying a pointer, which moved over a scale and indicated the position of the brush for a given reading. By means of a clamp screw this second wooden disc carrying the brush and pointer could be conveniently set at any point. Now, since the steel contact in the wooden disc is fixed relatively to the armature, it must share the ever-varying E. M. F. of the armature. Then evidently if the brush which completes the circuit through the contact be altered in position, values can be obtained for different points on the curves of E. M. F. and current.

The Ryan quadrant electrometer was used to measure the primary E. M. F., secondary E. M. F. and primary current. A condenser was connected in multiple with the electrometer. The primary current was measured by the fall of potential through incandescent lamps placed in series with the primary of the transformer. These lamps were carefully calibrated with the standard instruments of the laboratory, in order to know their resistance at different temperatures. Then knowing the resistance of the lamps and the potential difference at the terminals, the current flowing at once becomes known.

To measure the primary E. M. F. twenty-two 50-volt lamps were placed in series across the primaries. The elec-

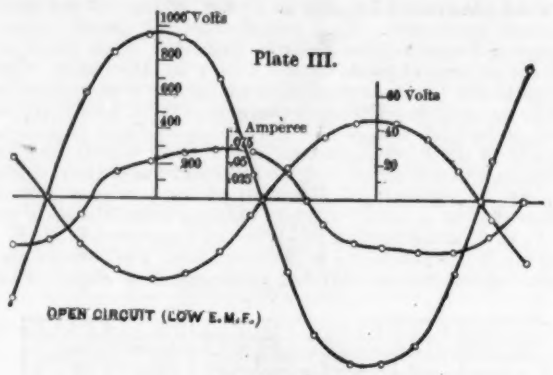


PLATE III.

OPEN CIRCUIT, LOW E. M. F.

BRUSH.	S. E. M. F.	P. E. M. F.	P. C.
19	24.5	595	.07
18	0.	0	.065
17	27.5	580	0
16	42.	870	.04
15	47.	965	.055
14	45.	950	.07
13	33.	715	.075
12	8.	180	.07
11	19.	420	.04
10	39.	835	.0+
9	45.	960	.065
8	46.	945	.07
7	38.	810	.075
6	16.5	395	.07
5	8.	210	.05
4	35.5	755	0

trometer was connected around two of these lamps, and the whole number calibrated, in order to know just what part of the total impressed E. M. F. was measured. The secondary E. M. F. was measured direct. The secondary current was measured by means of an electro-dynamometer, which was carefully calibrated both before

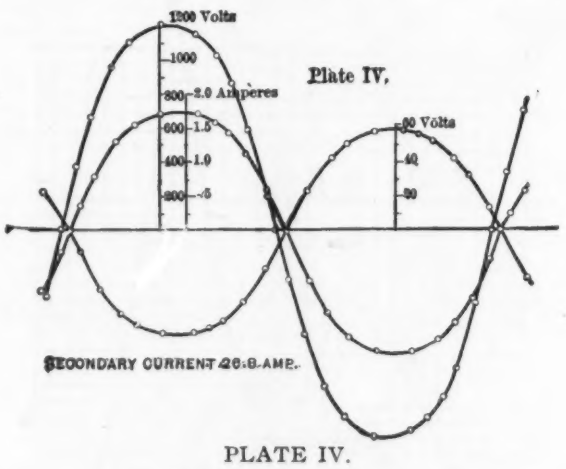


PLATE IV.

SECONDARY CURRENT, 26.8 AMP.

BRUSH.	S. E. M. F.	P. E. M. F.	P. C.
18.5	24.5	370	.82
18.	0.	0	.22
17.5	11.	410	.28
17.	30.5	743	.86
16.5	46.	980	1.25
16.	53.	1110	1.55
15.	59.5	1220	1.76
14.	57.5	1145	1.74
13.5	54.	1045	1.64
13.	47.	850	1.43
12.5	34.	565	1.06
12.	13.	200	.16
11.	21.	575	.58
10.5	37.	850	1.06
10.	47.5	1060	1.44
9.	58.5	1215	1.77
8.	59.5	1195	1.80
7.5	56.	1115	1.66
7.	52.5	995	1.58
6.5	42.	780	1.32
6.	27.	390	.9
5.5	10.	0	.34
5.	0.	325	.16

and after the experiments, and was found to be constant. The commutating device was placed in series with the electrometer. Wires were run from the terminals from which measurements were desired to a convenient switch-board.

In obtaining the Ewing card of hysteresis of the iron core of the transformer, current from a storage battery was sent through the secondary circuit, and the magnetization set up in the core was measured by the *kick* on a ballistic galvanometer in the primary circuit. The current in the secondary was gradually increased until the intensity of magnetization corresponded with the maximum magnetic density of the transformer when working on a 1,000-volt circuit. The current was then decreased gradually until zero was reached. It was then reversed and the method continued until a complete cycle of magnetization had been covered.

It is worthy of mention that this method which gives something so definite and fundametal in the treatment of the alternating current has only come into use within the past year, and the task of getting true instantaneous values of the complete waves of E. M. F. and current which has always been considered too tedious for ordinary patience to deal with was accomplished with ease in this work in 45 minutes. A calibrated scale for the electrometer readings added very much to the facility with which observations could be taken.

The marked improvement of the 40-light transformer over the 10-light is due, we believe, to an improvement in

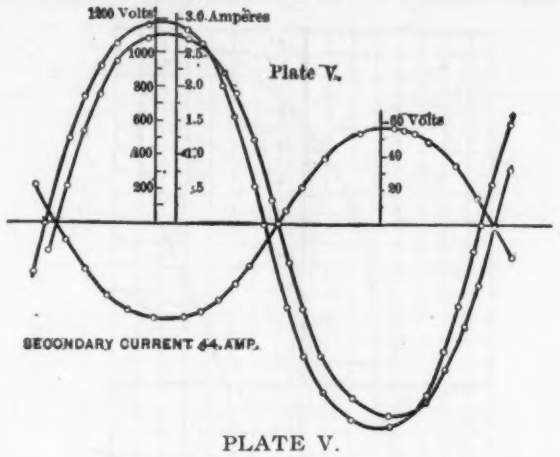


PLATE V.

SECONDARY CURRENT, 44 AMP.

BRUSH.	S. E. M. F.	P. E. M. F.	P. C.
19.	22.5	300	1.9
18.	0.	0	.37
17.5	10.	465	.525
17.	26.	745	1.3
16.5	39.	935	1.93
16.	48.5	1075	2.4
15.	55.5	1185	2.77
14.	56.	1150	2.67
13.5	51.	1060	2.58
13.	49.	835	2.3
12.5	47.	625	1.9
12.	35.5	230	1.13
11.5	21.	100	.32
11.	0.	505	.48
10.5	11.	795	1.3
10.	24.5	1015	1.98
9.	40.	1140	2.6
8.	54.	1200	2.84
7.5	57.5	1105	2.77
7.	55.5	1030	2.67
6.5	51.5	805	2.23
6.	45.5	510	1.69
5.5	32.5	130	.97
5.	17.	250	0.

the magnetic properties of the iron and a fewer number of turns in the coils, made possible by the better grade of iron.

In the 10-light transformer, Foucault currents were very effectually weeded out by the interposition of sheets of paper between the laminated sheets of iron; in the 40-light the oxide of iron on the surface of the plates was the only safeguard against Foucault currents.

The form and extent of the open-circuit curves show the loss due to hysteresis and the slight loss also due to Foucault currents. The presence of Foucault currents is indi-

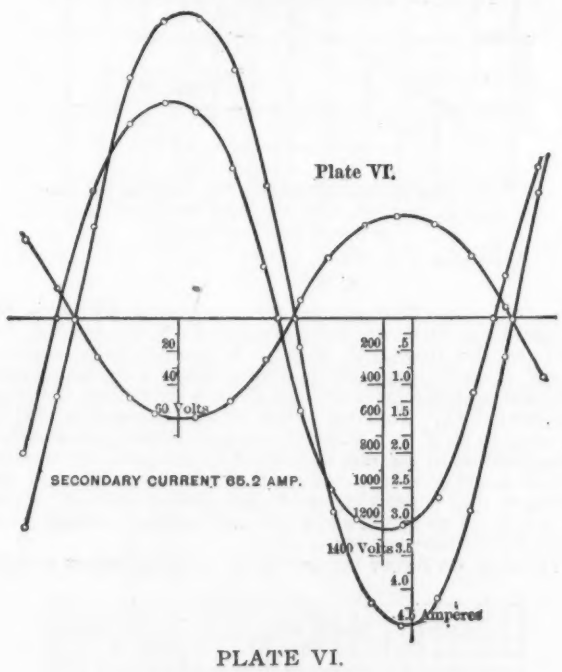


PLATE VI.

SECONDARY CURRENT, 65.2 AMP.

BRUSH.	S. E. M. F.	P. E. M. F.	P. C.
19.	45.	745	3.
18.	14.	0	1.08
17.	21.	730	1.23
16.	47.	1120	3.45
15.	58.	1245	4.3
14.	60.	1195	4.35
13.	51.	905	3.8
12.	26.	240	1.85
11.	8.	550	.4
10.	40.	1050	2.9
9.	53.	1225	4.1
8.	59.	1235	4.5
7.	55.	1070	4.25
6.	37.	475	2.83
5.	0.	235	0.
4.	29.	900	2.

cated by the fact that the maximum of the primary current wave does not occur simultaneously with the zero of primary E. M. F., but a little before. It is found upon analysis of the primary current curve into its elements, hysteresis and Foucault currents (see Plate XIII.) that the Foucault current component occurs 120 degrees in advance of the theoretical magnetization curve, and not 90 degress in advance, as has generally been assumed. Therefore when superimposed upon the hysteresis curve, it introduces a component in advance, and thereby decreases the lag of the primary current.

The primary current curve was again taken with the laminated plates loose and free to vibrate. The loss was about 10 per cent. less than the former case (Plate II.) This is thought to be brought about by the decrease in the hysteresis loss, due to the increased mechanical shock

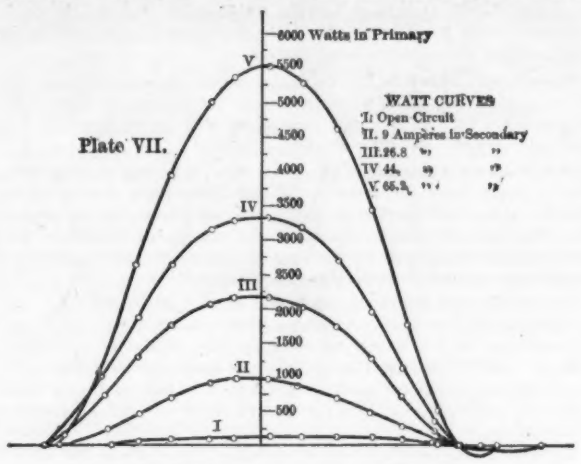
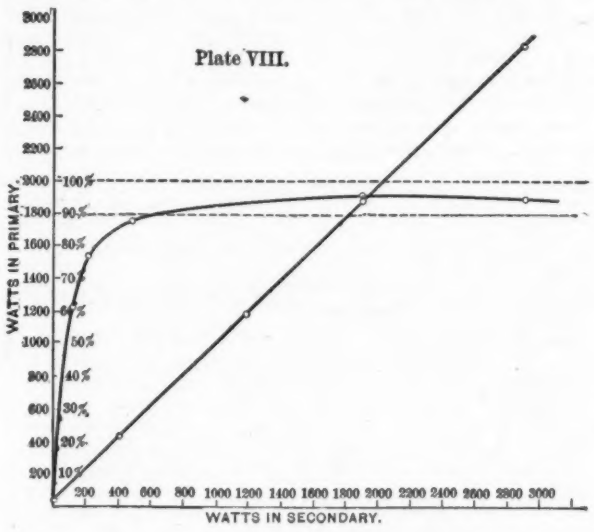


PLATE VII. WATT CURVES.

AMPERES IN SECONDARY

Open-Cir.	9	26.8	44.	65.2	Brush.
—22.1	0	0	180	0	18.
—7.6	148	630	960	1020	17.
30.6	400	1230	1750	2650	16.5
63.8	695	1720	2600	3860	16.
82.	880	2040	3080	4880	15.5
96.	970	2130	3250	5350	15.
105.	960	2160	3300	5520	14.5
116.	850	2020	3170	5250	14.
113.	700	1715	2700	4600	13.5
96.5	480	1220	1950	3440	13.
65.	150	600	1070	1800	12.5
22.8	50	115	253	443	12.
—10.5	0	0	—350	—96	11.5
—25.4		319	2500	220	11.



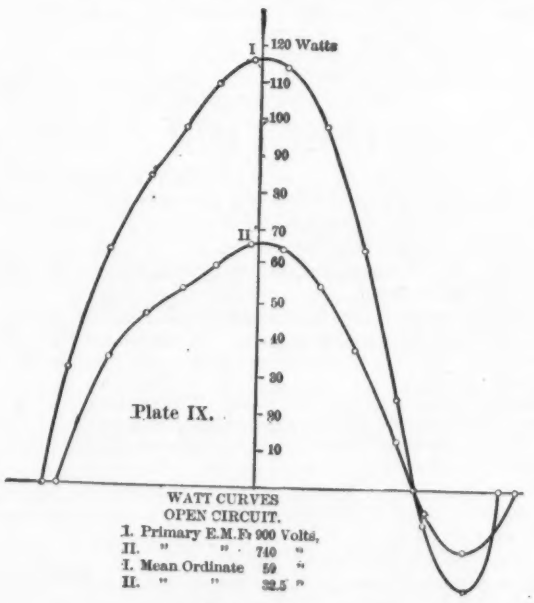


PLATE IX.

WATT CURVES. OPEN CIRCUIT.

No.	990 VOLTS.	740 VOLTS.
16.9	0.	
16.7		0.
16.5	30.5 Watts.	11.5
16.	64.	34.
15.5	82.	46.5
15.	96.	53.5
14.5	111.5	61.
14.	116.	66.
13.5	113.5	64.
13.	97.	54.
12.5	65.	35.5
12.	23.	12.5
11.7	0.	0.
11.5	—10.5	—7.5
11.	—25.	—17.
10.5	0.	7.
10.3		0.

arising from the free vibration of the plates. The vibration was very perceptibly increased. The curve obtained is more regular in form, indicating less hysteresis loss.

The lag of the primary current behind the primary E. M. F. is seen to be greatest when the secondary circuit was open, and decreases as a non-inductive load is introduced into the secondary circuit. This tendency of the lag of the primary current to decrease with increase of load continues until the curve of primary current comes into unison with the curve of secondary E. M. F.

The secondary E. M. F. is in unison with the primary E. M. F. on open circuit, and gradually falls behind as the load increases on the secondary. This is doubtless due to the leakage of lines of force arising from the enormous magnetizing forces at work in opposition to one another in the primary and secondary circuits.

When an inductive resistance is introduced into the secondary circuit, the lag of the primary current is greatly increased, as shown by the set of curves in Plate X. The inductive resistance used in this case was due to a small alternating current motor. The curve of secondary current was also taken, and found to lag behind the secondary E.

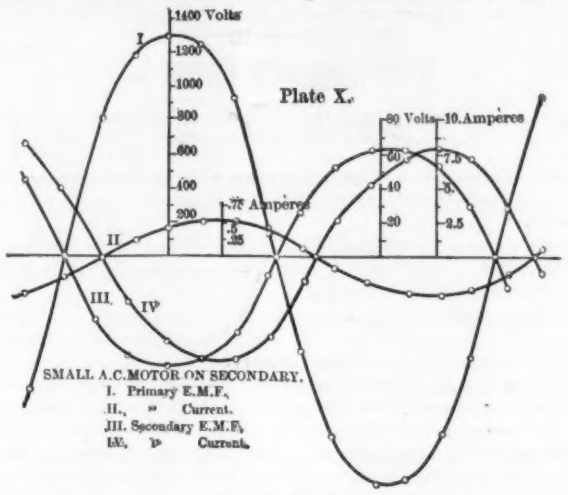


PLATE X.

SMALL ALTERNATING CURRENT MOTOR ON SECONDARY.

BRUSH.	S. E. M. F.	P. E. M. F.	P. C.	S. C.
19	30.	780	.53	7.36
18	0.	0	.35	4.48
17	40.	790	0	0.
16	60.	1195	.25	3.52
15	64.	1310	.43	6.2
14	61.	1240	.53	7.5
13	46.	930	.54	7.5
12	11.	140	.42	5.76
11	26.	570	.12	0.
10	55.	1115	.14	2.89
9	63.5	1305	.375	4.47
8	63.5	1310	.50	7.20
7	53.	1095	.55	8.32
6	27.5	560	.49	7.20
5	14.	290	.25	3.52
4	47.	950	.0	0.

M. F. and to be in unison with the primary current. About 5.5 ampères flowed in the secondary, and yet the lag of primary current is as great as on open circuit.

Plate XI. shows the relation of primary current and primary E. M. F. when the secondary was closed through the secondary of a 20-light transformer whose primary remained open. The current curve shows a distinctive lag from the inductive resistance and is altered in form to a great extent.

The outside loop in Plate XII. is the loop of total loss hysteresis and Foucault currents—deduced from the open

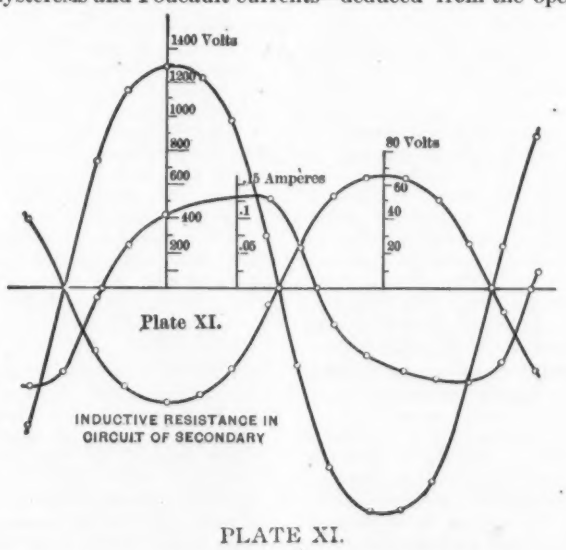


PLATE XI.

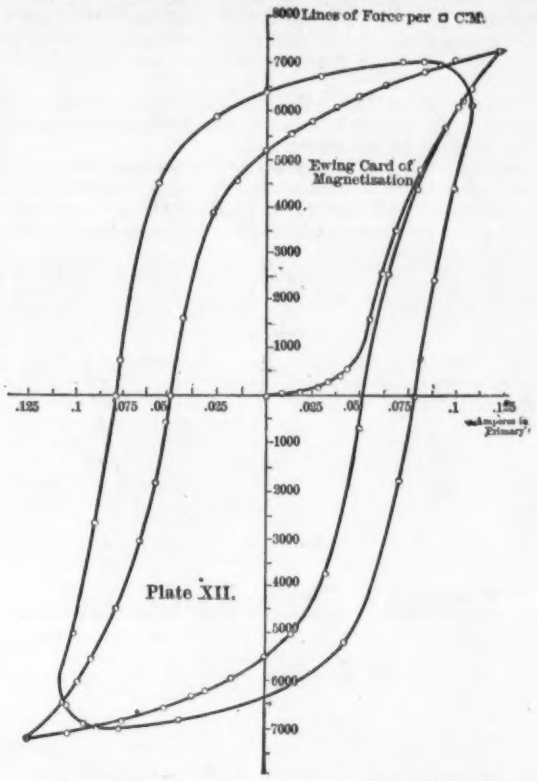
INDUCTIVE RESISTANCE OF SECONDARY.

BRUSH.	S. E. M. F.	P. E. M. F.	P. C.
19	39.	790	.147
18	0.	0	.126
17	40.	770	0
16	61.	1185	.066
15	67.	1310	.108
14	63.5	1245	.126
13	48.5	950	.135
12	11.	290	.135
11	26.	515	.06
10	56.	1105	.05
9	66.	1315	.099
8	65.5	1295	.12
7	56.	1105	.126
6	26.	545	.126
5	14.	260	.108
4	48.	930	0

circuit curves in the following manner. The current which flows to maintain the counter E. M. F. of the transformer on open circuit obviously includes the losses due to Foucault currents and hysteresis. If then a magnetization curve whose maximum has been computed be drawn in 90° behind the curve of primary E. M. F. and of the same form—since it is a function of the E. M. F.—and a curve be plotted using ordinates of primary current and abscissæ, and corresponding values of lines of force from the theoretical magnetization curve, as ordinates, the outside loop in Plate XII. is obtained.

The inside loop is the ordinary Ewing card of hysteresis loss found by carrying the iron slowly through a complete cycle of magnetization. The lines of force were computed from the *kick* on a ballistic galvanometer. This card has in it no Foucault current effects. If then we reverse th above method, and from the Ewing card and the magnetization curve deduce a primary current curve, we shall have a curve representing hysteresis (for this iron) loss.

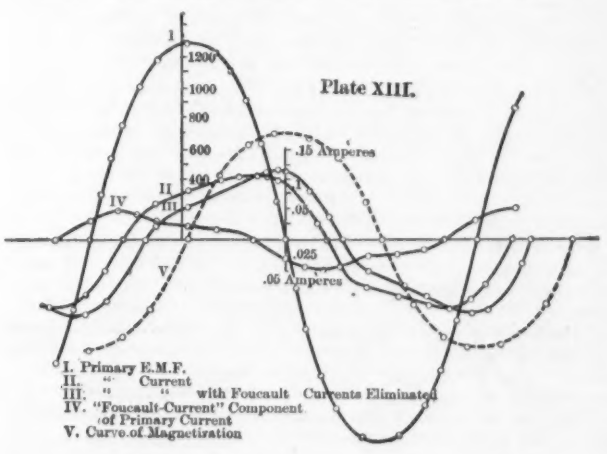
This was done, and it is of especial interest to note that

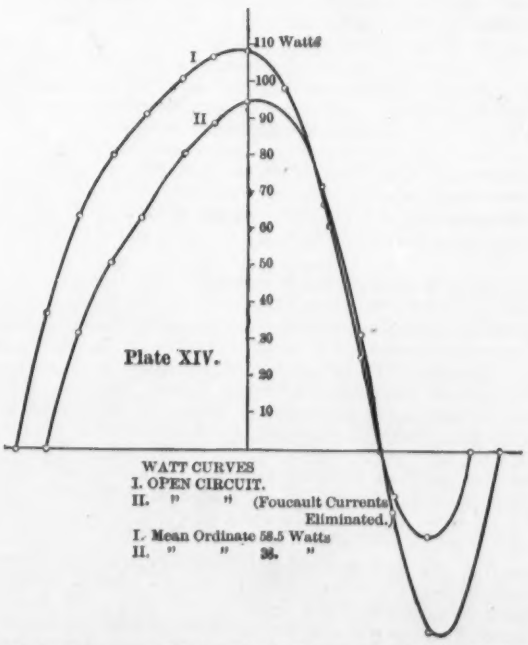


Values of lines of force per sq. cm. multiplied by .64.

PLATE XII. EWING CARD.

No.	P. Current.	C. G. S. Lines per □ c. m.	No.	P. Current.	C. G. S. Lines per □ c. m.
1	.01	36	24	—.015	4445
2	.02	96	25	—.027	3828
3	.03	180	26	—.042	1600
4	.035	246	27	—.05	490
5	.04	312	28	—.058	1890
6	.045	420	29	—.067	3020
7	.053	635	30	—.078	4425
8	.058	1630	31	—.09	5565
9	.063	2548	32	—.095	6065
10	.07	3515	33	—.103	6615
11	.083	4775	34	—.12	7200
12	.095	5045	35	—.103	7125
13	.105	6312	36	—.085	7028
14	.11	6635	37	—.07	6812
15	.12	7120	38	—.05	6615
16	.102	7075	39	—.037	6410
17	.087	6880	40	—.03	6270
18	.063	6555	41	—.015	6095
19	.05	6350	42	0	5665
20	.04	6180	43	.033	3820
21	.027	5892	44	.067	2550
22	.015	5644	45	.103	6240
23	.0	5124	46	.12	7005





the form of curve obtained in this manner is identical with the open circuit curve of the 10-light transformer in which Foucault currents were suppressed by the interposition of sheets of paper (see curve III. Plate XIII.) Having then two curves plotted to the same scale, one representing total loss and the other hysteresis loss, if we subtract ordinates of the latter from corresponding ordinates of the former, a

curve representing the component due to Foucault currents will be obtained (curve IV. Plate XIII.) It was in this manner that the analysis before referred to was made. The position of the Foucault current component accounts for the round corners in the outside loop of Plate XII.

From Plate IX. will be seen the watt curves for open circuit loss, one for 990 volts and the other for 740 volts. From the value of the mean ordinates it is seen that the loss varies strictly as the square of the impressed E. M. F.

In Plate II. is plotted to the same scale the current which flowed on open circuit in case of the 10-light transformer and the 40-light transformer.

Plates IV., V. and VI. show the curves of primary E. M. F. and current and secondary E. M. F. for different loads, from which the watt curves of Plate VII. are computed by taking the product of corresponding ordinates of primary E. M. F. and current.

The efficiency curve shown in Plate VIII. is the ratio between the energy of the primary circuit as indicated by the mean ordinate of the watt curve, and the energy of the secondary circuit as expressed by the product of the $\sqrt{\text{mean}^2}$ readings for E. M. F. and current. The coercive force is equal to 0.8, C. G. S.

These considerations go to show that the loss due to the reversal of polarity of the iron, which perhaps must always be present, may be reduced almost indefinitely by a proper study of the magnetic properties of the iron used.

The watt curves in Plate XIV. show the relation between the total loss on open circuit and the loss if Foucault currents were eliminated.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-177 TIMES BUILDING, NEW YORK, June 28, 1890.

The Consolidated Electric Light Company, of New York, has declared a quarterly dividend of 1½ per cent. for payment July 1.

Perth Amboy, N. J.—The New York office of the Fort Wayne Electric Company has closed a contract with the Raritan Electric Light and Power Company for a 600-light Slattery alternating incandescent plant.

Amsterdam, N. Y.—A company composed of New York, Philadelphia and Amsterdam capitalists has purchased the Amsterdam street railroad, and will at once begin the construction of an electric road. It is to cost over $250,000, and will be completed by Sept. 1.

Steam Heating Company.—The Grand Jury began an investigation last Thursday to determine the cause of the street explosions in Broadway. They examined Commissioner Gilroy, whose opinions as to the responsibility for the explosions have already been made public.

The New York Insulated Wire Company, 649 and 651 Broadway, New York City, shipped to St. Paul this week one car load of assorted Grimshaw wire and tape and next week will ship two car loads of Grimshaw to St. Louis. Other large shipments are being made to San Francisco and other cities on the Pacific Coast.

The Edison Electric Illuminating Company's first mortgage five per cent. convertible gold bonds, to the amount of $1,500,000, have been listed on the New York Stock Exchange. These bonds are convertible into stock after 1891. An additional $260,000 first mortgage five per cent. gold bonds of the Laclede Gas Light Company, of St. Louis, have also been listed, making a total of $9,975,000 of this company's securities now listed.

Mortgage on an Electric Line.—The Metropolitan Trust Company, of New York, has taken a mortgage for $150,000 against the Watervliet Turnpike and Railroad Company at Albany, N. Y. The amount is to secure $150,000 bonds at six per cent., payable in 1919. This road recently changed its motive power to electricity, and has since been involved in litigation with the telephone companies over the use of the single trolley system.

The Anglo-American Gas Syndicate has filed a certificate of incorporation at Trenton, N. J., under the title of the American Gas Investment Company, with a capital stock of $50,200,000. The odd $200,000 is founders' stock. There are $10,000 of the above amount paid in, and George S. Bixby, H. W. Thorne and William Talcott are named as directors. The objects are to construct, acquire, own, manage and operate works for the manufacture, distribution and supply of light, heat and power by gas, electricity or other means, and to acquire stocks and properties of other corporations formed for any similar purpose, and to deal in the same.

A New Block Signal.—On the morning of June 28 a test of the Desant Electric Company's audible block signal system was made on the Suburban Elevated Railroad, New York, in the presence of a number of newspaper men and railroad experts. The test was in every way successful. The Desant signal rings a bell or blows a whistle in the cab of an engine entering a block that is occupied by another train. The whistle continues to blow until the train ahead leaves the block. The arrangement can be used in connection with a visual block signal, and certainly provides an additional safeguard against rear-end collisions. Governor Campbell, of Ohio, is president of the company, and Wm. F. Z. Desant is its vice-president. It has offices in Columbus, O., and at 45 Broadway, New York.

American Institute of Electrical Engineers.—At the meeting of the Institute council held June 17 the following applications for associate membership were presented by the secretary and were approved by the council: Cleveland F. Dunderdale, agent Westinghouse Electric Company, 146 Adams street, Chicago, Ill.; Eugene R. Holcomb, electrician, agency Thomson-Houston Electric Company, 234 Montgomery street, San Francisco, Cal.; H. A. Sinclair, electrical engineer, the Tucker Electric Company, 950 Bedford avenue, Brooklyn, N. Y.; F. H. Chamberlain, electrician, Metropolitan Railroad Company, 2411 P street, N. W., Washington, D. C.; George Cutter, dealer in electrical supplies, 192 Fifth avenue, Chicago, Ill.; John S. Cobb, with S. R. Krom, general manager and mining engineer, 151 Cedar street, New York; J. P. B. Fiske, electrical engineer, Thomson-Houston Electric Company, Lynn, Mass.; H. G. Reist, electrical engineer, Thomson-Houston Electric Company, 113 Franklin street, Lynn, Mass.; Jas. B. Cahoon, electrical engineer, Thomson-Houston Electric Company, 257 Washington street, Lynn, Mass.; Axel Ekstrom, electrician, Thomson-Houston Electric Company, Lynn, Mass.; R. B. Owens, superintendent, Greenwich Gas and electric Light Company, Greenwich, Conn.; Geo. L. Colgate electrical engineer, Bedford Electric Company, Bedford City, Va.; Geo. Francis Myers, laboratory of Wm. Stanley, Jr., U. S. Electric Light Company, Newark, N. J.; Auguste F. Mason, general manager, Simplex Electric Company, 620 Atlantic avenue, Boston, Mass.; Harvey L. Lufkin, general agent, "C & C" Electric Motor Company, 404 Greenwich street, New York; William H. Powell, New Britain, Conn.; M. J. Francisco, president and general manager, Rutland Electric Light Company, Rutland, Vt.

The following applications for transfer from associate to full membership were also approved by the council at the same meeting: A. J. Lawson, electrical engineer and contractor, Montreal, P. Q.; Charles H. Davis, consulting electrical engineer, 120 Broadway, New York; Morgan Brooks, secretary and treasurer St. Paul Gas Light Company, St. Paul, Minn.; Dugald C. Jackson, asst. engineer, railway department, Sprague Electric Railway and Motor Company, New York; Francis E. Jackson, Edison Lamp Company, Harrison, N. J.; Dr. Louis Bell, editor THE ELECTRICAL WORLD, New York; Theodore Stebbins, Thomson-Houston Electric Company, railway department, Boston, Mass.

W. T. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
No. 146 Franklin, corner Congress St.
BOSTON, June 28, 1890.

The Central & South American Telephone Company has filed a certificate increasing the capital from five to six million dollars.

The Thomson-Houston Electric Company's dividend on series "C" and series "D" stock was made payable July 1 to stockholders of record June 25.

C. D. Smith, representing the Scott Carbon Company, of Cleveland, was in town this week. Mr. Smith reports business as good, and the demand for his goods as increasing.

The West End Street Railway will probably open the new electric line between Park square and Oakland Garden on Monday next to accommodate patrons of the "Fall of Babylon."

Mr. E. E. Newell, for six years telegraph operator for the Boston & Maine Railroad, Associated Press correspondent at Exeter, N. H., has been appointed superintendent of the Dover & Great Falls electric street railway.

Gloucester, Mass.—At the meeting of the Board of Aldermen, June 24, an order was adopted requiring the immediate removal of all dead wires and poles not in use, requiring all dangerous wires to be made safe, and the placing of all wires used by companies and corporations four feet below the fire-alarm wires.

Lynn, Mass.—Nearly 200 employés on the second floor of factory "C," of the Thomson-Houston Electric Works, quit work last Monday afternoon, demanding the discharge of an alleged spotter. Work was suspended for over two hours when the matter was satisfactorily adjusted.

The Boston Steam Heating Company's bondholders are to be given possession of the property. There is some $75,000 to $100,000 worth of land, besides buildings and the extensive system of unused pipes buried in the streets. Messrs. Drexel, Morgan & Co. hold the bonds as collateral for loans made to the company.

A. W. Carey, of the Thomson-Houston Electric Company, has been put in charge of the Ware Electric Light Company and the Orange Electric Light Company, together with several other Massachusetts companies, and is rapidly reorganizing them. The introduction of the meter system, as one factor in the equipment, has produced good results.

Lynn, Mass.—It is announced that the Thomson-Houston Electric Company has secured the estate of John Welch on Berkeley street, for which negotiations have been for a long time pending. By this purchase it will be able to run the spur track from the Saugus branch of the Boston & Maine Railroad as originally laid out to the shipping department in factory H, and thence to the new factory C extension, and the testing house now in process of erection on Federal street.

A Notable Wedding occurred at Nashua, N. H., at 1.30 o'clock on the afternoon of June 24. The contracting parties were Mr. Hollon C. Spaulding, general manager of the Thomson-Houston Motor Company, of Boston, and Miss Lucille Brisbane, of Nashua. The ceremony was at the Church of the Good Shepherd, Rev. W. H. Moreland, rector, officiating. The music was something elaborate, being sung by a vested choir of forty boys. The church was handsomely decorated and crowded with the friends of both parties. Mr. Fred B. Lovejoy, of Boston, was the best man, Miss Sophia Walton, of New York, maid of honor, and six young ladies served as bridesmaids. The bridal party left for Boston in a special car on the 3.47 P. M. train, where a wedding dinner was served at Young's Hotel. The honeymoon will be spent in a trip to California, and on their return Mr. and Mrs. Spaulding will make their permanent residence in Boston.

Fifty members of the Boston Electric Club celebrated the Club's third anniversary by an outing at Marblehead Neck on Saturday last, leaving Boston at 12.30. They arrived at Marblehead station about 1.30, where busses conveyed them to the hotel. After enjoying one of the celebrated "fish dinners" for which the "Nanepashamet" is so famous, outdoor sports were indulged in. Two rival baseball nines, under the captaincy of Dustin Killicut and Commodore Stow, occasioned the most merriment. Among the notable features of the game were the unique and marvelous work of short-stop Cram, Pettingell's heavy work with his high white hat, centre fielder Barker's numerous foul tips, and other brilliant plays too numerous to mention. The scorers got tired and therefore no reliable score could be obtained, but it is rumored that the umpire (who escaped by a fast sailing yacht) was bribed and that the end is not yet. At 5.30 the party returned to Boston well pleased with their outing. It is the wish of a majority that these pleasant outings be held oftener as they tend to make life happier and pleasanter in many ways.

L. H. H.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
465 The Rookery, Chicago, June 28, 1890.

Grand Forks, Minn.—The Grand Forks Water, Light and Power Co., with a capital stock of $100,000, has filed articles of incorporation with the secretary of state.

Ypsilanti, Mich.—It is reported that an electric railroad is to be built along what is known as the "south road" between Ypsilanti and Ann Arbor, a distance of eight miles.

Mr. James E. Wilson, of the Western Power Construction Company, The Rookery, Chicago, started last week for Boston, New York, and Washington on a business trip for the company.

The Economy Light and Power Company has been incorporated at Chicago to furnish light, heat, and power. Capital stock, $400,000. Incorporators, W. H. McSurely, C. H. Briat and Mr. Holmer.

Ottawa, Ill.—The city council is considering the bids of several electric light companies, with the intention of erecting electric light works, to be owned and operated by the city. The plant will cost about $20,000.

Mr. Frederic N. Bosson, the electrical mining expert of the Thomson-Houston Electric Company, has been placed in charge of all its mining work in the North, and has established his headquarters in Marquette, Mich.

Mr. M. C. Wheaton, of the Chicago office of the Thomson-Houston Electric Company, had the satisfaction of securing a contract this week for 350 arc lights and 3,000 alternating incandescent lights of the Thomson-Houston system.

Bessemer, Mich.—The construction of the largest electric light plant in the Lake Superior country, capable of furnishing illumination for half a dozen mines, as well as for the city, was begun last week. It will cost about $75,000.

Mr. Julius Andrea, Milwaukee, Wis., is wiring the Davidson Opera House and the Loan and Trust Company's new building. Mr. H. P. Andrea, secretary of the company and a leader among the wheelmen in the Northwest, was one of the 150 riders that gathered at Waukesha on the 20th inst., and was honored with a handsome portrait in the Milwaukee *Sentinel*.

The Chicago Electric Club had a very enjoyable and successful meeting on Friday evening of this week. Two interesting papers were read on timely subjects by Mr. Pumpelly and Prof. Siebel. The flourishing character of the club was well shown by the interest manifested at this meeting, the harmony and good cheer prevailing making the future success of the club an assured fact.

Detroit, Mich.—A bill of complaint was filed in the United States Circuit Court last week by the Brush Electric Light Company asking for an injunction to restrain the Detroit Electric Light and Power Company from erecting iron towers for lighting purposes in the city of Detroit. The case was to be brought before Judge Brown on June 28. Both a preliminary and permanent injunction are asked for.

Mr. Charles Munson, president of the Charles Munson Belting Company, with his wife, son and daughter, were driving along one of the streets in this city one evening this week when the horses became frightened and ran away. The carriage was overturned and the occupants were thrown into the street. Fortunately, the injuries sustained by Mr. Munson and the members of his family were very slight.

Detroit, Mich.—The storage battery cars recently completed at the Detroit Electrical Works for the Middlesborough (Ky.) street railway made an exhibition trip last week with Manager Eugene H. Hill, of the Pumpelly Storage Battery and Electric Motor Company, of Chicago, in charge of the car. The battery used in this car cost about $750, and Manager Hill says it certainly represents a life of 2½ to 3 years, or an annual outlay in the waste of the battery amounting to $250 or $300. To this Mr. Hill says may be added the cost of operation, fairly estimated at 1½ cents per horse power per hour, or, in other words, to charge the battery for an eight-hour run of 60 miles would cost 90 cents.

Telephone Quotations.—Col. S. G. Lynch, broker, 153 Monroe street, Chicago, furnishes quotations on telephone stocks as follows:

Chicago	$298@$300	Cumberland	$ 59@ $60
Central Union	69@ 70	Wisconsin	116@ 117
Michigan	98@ 99	Bell of Missouri	140@ 145
Great Southern	30@ 32	Iowa Union	21@ 23
Colorado	38@ 40	Missouri and Kansas	54@ 55
Rocky Mountain Bell	40@ 45		

ELECTRIC LIGHT STOCKS.

Chicago Arc Light and Power	$104@$105	Chicago Edison Co	$125@$130

The Telecone.—This instrument, the invention of James L. Cutler, of Piketon, O., is designed to control any individual signal at any desired point on a main line circuit. By its use a signal at any point can be shown without disturbing any other signals on the same circuit, or an individual call can be addressed to any office and an electric bell rung without disturbing any other bells on the main circuit. Its action is not dependent upon relays of different resistances nor upon clockwork or synchronous mechanism. It is worked by the ordinary transmitting key and makes use of the Morse alphabet. Each instrument upon a given circuit is designed to respond to a given arrangement of dots and dashes and will only be affected when its proper call is made. The instrument can be used on telephone lines, patrol systems, and for many other purposes requiring the use of such a call.

F. De L.

SOUTHERN NOTES.

NORFOLK, VA., June 26, 1890.

Newly Incorporated.—The Obed River Telegraph and Telephone Company has been incorporated at Crossville, Tenn.

Contemplated Transfer.—G. W. Ascough intends to move his electro-plating works from their present location in Quincy, Ill., to Memphis, Tenn.

An Innovation in Railroad Cars.—The Chesapeake & Ohio Railroad Company has introduced electric fans in some of the cars on the line. The cars of this railroad are also lighted by electricity.

Chattanooga, Tenn.—A company is being organized by T. J. Serrel, J. A. Hart, S. R. Read, and others, to establish works to generate steam by electricity, by a new process patented by T. J. Serrell.

A Stockholders' Meeting.—There was a general meeting of the stockholders of the Universal Electric Railway Signal Company held at Richmond, Va., on Wednesday, June 25, at which important private business was transacted.

A Superintendent Caned.—The employés of the Asheville Electric Street Railway Company, of Asheville, N. C., recently presented the superintendent of that railway, Capt. T. W. Patton, a handsome gold-headed cane, as an evidence of their high esteem and appreciation.

Baltimore, Md.—The Instantaneous Fire Alarm Company, with a capital stock of $20,000, has been incorporated by John Walters, Frank Popplein, Michael Sheehan and others. The object of the company is to manufacture a recently patented system of instantaneous fire alarms.

Electric Railway Signal.—Mr. W. J. Sheldon, of Martin's Ferry, W. Va., who is the patentee of a number of electrical appliances, has recently invented a new and novel railway crossing signal, whereby the train approaching the crossing causes a bell to ring and a sign bearing the words "Train Coming," to spring into sight. At night, the bell rings and a red glass sign, bearing the same words, and illuminated by a small incandescent light, serves the same purpose. The whole device is automatic, and requires no attention, whatever, and is so constructed that a train 3,000 feet away, puts it in operation. The train in passing over the crossing, stops the bell from ringing, and resets the signal.

The Atlanta (Ga.) Electric Club.—Another evidence of the widespread interest in electrical engineering and the various applications of electricity and of the development of the electrical industries in the South, is the organization of an Electric Club at Atlanta, Ga., quite recently. The Club starts out with 40 charter members, including all of the leading electrical men of the city, and 10 additional applications for membership have since been re-

ceived by the board of managers, of which Mr. F. E. Clarkson is chairman. The club rooms are finely furnished and are provided with all the latest club room facilities,—incandescent light, telephone, telegraph call boxes, phonograph, phonograph-graphophone, billiard and pool tables, etc. Everything is organized and arranged in accordance with the requirements of a complete and successful club.

Asheville, N. C.—A party of northern gentlemen has been stopping at the Battery Park Hotel, en route to the summit of the Blue Ridge in Jackson County. The first arrivals were Messrs. A. H. Fuller, publisher of the Brockton (Mass.) *Enterprise*; Horace Richmond, E. P. Jenks, and E. M. Thompson, of Brockton, Mass., and these were followed two days later by Messrs. S. E. Barton, president of the Electric Mutual Insurance Company, of Boston; J. W. Phinney, of Stoughton, Mass.; W. D. MacQuesten and Luther Stieringer, electrical engineers; W. J. Jenks, electrical expert of the Edison Electric Light Company, and E. F. Davis, electrician, all of New York city. A club headquarters, capable of accommodating 20 to 30 members, has been erected on the main top of the mountain, at an altitude of about 4,760 feet, overlooking several thousand acres which have been acquired for the purpose of a game preserve. In May of last year a small party of friends, which included Mr. P. H. Alexander, of the Sawyer-Man Electric Company, stopped here on their return from a 10 days' trip from Hillsboro, through Franklin Highlands, Cashier's Valley, and Brevard, down the French Broad. The isolated location and remarkably heavy timber of the section north of Hogback Summit, as well as the number of bear, deer, otter, and other animals, which there find a natural harbor, led two or three of these gentlemen to acquire this property, and their action at this time is the result of this decision.

Y. N. B.

ENGLISH NOTES.

(*From our own correspondent.*)

LONDON, June 18, 1890.

The Development of Electric Traction.—A company with a million capital will shortly be brought before the public for the purpose of working the Thomson-Houston and series systems of electric traction. It is said that contracts have been entered into to the extent of £750,000 for equipping tramways in various parts of the country.

The Ferranti Cable.—Men are now actively engaged in running the Ferranti cable from Deptford to London, and the line is now complete as far London Bridge Station, so that this cable, which according to official statements, has successfully stood tremendous electric pressures in the factory, will soon be tested under working conditions. It is needless to say that the outcome of this practical trial of the Ferranti cable is awaited with some anxiety by the electrical fraternity.

The Board of Trade Regulations With Regard to Overhead Wires.—At the last meeting of the Electrical Trades Section of the London Chamber of Commerce, the chairman, Mr. R. E. Crompton, held forth, not without good reason, against the rules of the Board of Trade with regard to overhead electric light conductors. Rule 9, which is as follows, is the particular one which seems to need revision: "Every high-pressure aerial conductor must be continuously insulated with a durable and efficient material to be approved by the Board of Trade, to a thickness of not less than one-tenth part of an inch, and in cases where the extreme difference of potential in the circuit exceeds 2,000 volts, the thickness of insulation must not be less in inches or parts of an inch than the number obtained by dividing the number expressing the volts by 20,000. This insulation must further be efficiently protected on the outside against injury or removal by abrasions. If this protection be wholly or partly metallic it must be efficiently connected to earth, so, however, as not to cause undue disturbance to other electric lines or works by electrostatic induction or otherwise." When this rule was considered by the committee of the Institution of Electrical Engineers, it did not occur to any of the committee to think out what the result of it would be. Mr. Crompton, however, who has recently had to run overhead wires in connection with the Chelmsford lighting, and who has been requested by the Board of Trade to run his wires in accordance with its rules, has been the first to discover that they result in what he graphically terms a "pudding" instead of an ordinary insulated conductor. In fact, it is the opinion of Mr. Crompton, and several others of equal practical experience, that the rigid enforcement of Rule 9 would be practically prohibitive of electric lighting in a number of localities where it could at present be carried on remuneratively by means of overhead wires. As the Board of Trade, after having had concrete examples placed before it of the cables which its regulations produced, has refused to amend this rule, it has been decided to send a resolution to the Board of Trade calling attention to the matter once more. It is also proposed to raise the question in the House of Commons.

News of the Week.

THE TELEGRAPH.

Taxing Telegraph Companies.—The joint committee from the North Carolina legislature last week examined the affairs of the Western Union Telegraph Company in that State. This company pays in North Carolina taxes only upon those messages sent to points within the State. The committee decided to recommend a tax per mile on all the company's lines in North Carolina.

A Telegrapher's Secondary Occupation.—The statement is made that one-third of the telegraph operators of the country are continually preparing themselves for other professions, while the other two-thirds are continually thinking of doing so. Of the 100 men working on the regular night force in the Western Union main office at 195 Broadway, New York City, 36 of them are either studying or working at something else during the day. They are divided up as follows: Doctors, 8; lawyers, 6; ministers, 3; brokers, 3; actors, 2; theatrical managers, 2; real estate dealers, 2; inventors, 2; book agents, 1; manufacturers, 1; civil engineers, 1; authors, 1; commercial business, 1; electrical supply agents, 1; composer of music, 1.

A Suit Decided Against the Western Union.—Judge Brown, in the United States District Court, New York city, awarded damages last week to the amount of $2,000 in the suit brought by the Inman and International Steamship Company against the Western Union Telegraph Company for injuries to the wheel of the steamer "City of Richmond," which struck some submerged telegraph cables in the North River, near the Dutch Steamship Company's pier, Jersey City. The telegraph company brought a cross suit for $10,789 for injuries to the cable and $50,000 for loss of the use of the cables. Judge Brown dismisses the libels of the telegraph company, but gives damages to the steamship company on the ground that the Western Union cables at the place of the accident are an interference with navigation.

The Liability of Telegraph Companies.—Two important decisions have recently been given in two states, regarding the liability of telegraph companies for failure to deliver messages promptly; one of these comes from Georgia, Judge Harden, of Savannah, rendering a decision on the demurrer in the case of W. C. Jones vs. the Western Union Telegraph Company. The court sustained the demurrer, deciding that the act of the Legislature, giving the right to recover $100 for failure to deliver promptly and accurately, did not apply when the telegram was sent from one state to a point in another state. Within the state the penalty could be recovered, but between the states Congress had authority under the constitutional provision regulating commerce among the states. The other decision is from the Kentucky Court of Appeals, and was briefly summarized in a recent issue of THE ELECTRICAL WORLD.

THE TELEPHONE.

A Cable Telephone.—Sullivan's Island, a seaside resort near Charleston, S. C., is to be connected with the latter city by telephone, the line being a cable between the two points. The work of laying the cable will be begun next week.

The Pacific Bell Telephone Company, of San Francisco, Cal., has offered to furnish 83 telephones complete for the new police patrol signal system at an annual rental of $15 each, provided the telephones are erected separately and not connected with the Telephone Exchange.

The International Bell Telephone Company has declared a dividend of three per cent. for the half year, payable July 1. The company offers to buy $50,000 of its own stock at not exceeding par, from the proceeds of the redemption in cash of its holding of founders' shares in the Nederland Bell Telephone Company of Holland.

At Rio de Janeiro, Brazil, an electrical section has been established by the Public Works Company of that country. This company has lately made a contract with the Brazilian Government to operate all telephone works of the capital, and has appointed as manager Mr. Carlos Monteiro e Souza, a very well known Brazilian electrician, who has been in this country studying the various electrical applications, and has been agent for Mr. Edison in South America. Beside the telephone works this company exploits all sorts of electrical appliances in Rio de Janeiro and throughout Brazil.

Editors at the Long Distance Telephone.—The 400 editors who were in Boston last week attending the convention of the National Editorial Association were entertained one evening at the rooms of the Boston Press Club by the songs of Marie Halton at the "Casino" in New York City. The American Telephone and Telegraph Company arranged this treat for the editors, who called repeatedly for this music and a cornet solo, in the offices of the company at 18 Cortlandt street, New York, pleased them so much that they had it repeated no less than half a dozen times. The editors in Boston said that they could hear the orchestral music and the solo singing almost as plainly as if they had been present in the Casino.

The Tropical American Telephone Company closed its books July 1 for the annual meeting July 30. The company reports its business increasing, and its field broadening every month, and the management hopes to show that it has earned 10 per cent. on four dollars per share of capital stock (or four per cent. on its par value of $10 per share). It will start the new year with large orders to execute, among them being one for 500, one for 300, and one for 100 complete sets of telephone apparatus. On July 1 the company acquired the control of the Williams' annunciator drop, patented April 8, 1890, and used in all small exchange switchboards. This will enable the company to manufacture its own switchboards, and levy a royalty on all drops of this pattern used in the United States.

The American Bell Telephone Company's statement of the output of telephones for the month ended June 20, makes the following comparisons:

June.	1890.	1889.	Inc.
Gross output.....	7,758	6,511	1,247
Returned.....	1,927	2,094	*167
Net output.....	5,831	4,417	1,414
Dec. 21 to June 20:			
Gross output.....	33,577	30,216	3,361
Returned.....	12,104	11,281	823
Net output.....	21,473	18,935	2,538

*Decrease.

THE ELECTRIC LIGHT.

Pulaski City, Va.—An electric light plant is to be established shortly.

At Henrietta, Tex., Messrs. Fay & Brown contemplate the establishment of an electric light plant.

Lawrenceburg, Tenn.—An electric light plant will be established by the Lawrenceburg Land Company.

Wilson, N. C.—An isolated incandescent electric light plant is being added to the equipment of the Wilson cotton mills.

Henderson, Ky.—An isolated electric light plant will be put into a hotel now being built by Messrs. C. F. and L. P. Keiderer.

Fort Payne, Ala.—Another dynamo will probably be added to the plant of the Fort Payne Electric Light and Power Company.

Blacksburg, S. C.—The Schuyler Electric Light Company, of Middletown, Conn., has been awarded a contract to erect an electric light plant.

Turned on the Light.—The newly completed electric light plant at Portsmouth, Va., of the Citizens' Electric Light Company, turned on the light a few nights ago for the first time.

Milledgeville, Ga.—A 70 h. p. boiler and a 60 h. p. engine are to be added to the plant of the Milledgeville Electric Light Company, thus increasing its present capacity considerably.

Malden, Mass.—At a meeting of the Common Council, Monday evening, the committee on street lights was authorized to make a contract for electric street lighting for the ensuing year.

Camden, N. J.—The contract for street lights has been awarded to the Camden Electric Light Company at 40 cents per light per night for arc lights and 20 cents each for incandescent lights.

Detroit, Mich.—The Detroit Electric Light and Power Company has commenced the erection of a tower at the corner of Fort street and Woodward avenue within the curb of the City Hall sidewalk.

Rockville (Ind.) streets are shortly to be lighted by the Westinghouse alternate current arc light system. A plant of 50 lights has already been contracted for and the installation of the machinery is to be commenced immediately.

Philadelphia, Pa.—Mr. C. S. Knight, of the Fort Wayne Electric Company, has just closed a contract with the United Gas Improvement Company for 600 new Wood arc lights to be run in connection with its Kansas City gas works.

The Wilkinsburg Electric Light Company, operating the Thomson-Houston system, has gotten down to business. It starts off with a capacity of 750 lights. Its station is a well arranged wooden building advantageously situated.

Newport, R. I.—The Edison Electric Light Company proposes to run its electric light wires throught Beach street and Rhode Island avenue, so as to furnish light for the new cottages of Mr. Addison Thomas and Mr Zabriski, on the latter avenue.

The Merchants' Electric Light and Power Company, of Frankfort avenue, Philadelphia, Pa., is an organization, which has recently been established there by prominent citizens of the "City of Brotherly Love." The company has given a contract to the Westinghouse Electric Company for one of its 750-light alternate current dynamos with necessary accessories.

The Westinghouse Electric Company installed its alternate current apparatus not long ago in Salt Lake City, Utah, and now the report has been made that another town in that territory is about to establish an electric light plant within its precincts. A company has lately been organized in Ogden, Utah, and the Westinghouse Electric Company is going to install alternate current apparatus for a central station plant of 1,500 incandescent and 80 arc lights.

Eaton Rapids, Mich.—Messrs. C. S. and E. E. Horner, the managers of the electric light plant at this place claim that their system is giving entire satisfaction to the public, notwithstanding the rumor to the contrary, which they claim was false. In the two years that the plant has been in operation it has been stopped but two or three nights, and then only for a part of an evening on account of some unavoidable break in the dam or race. The Thomson-Houston arc and incandescent systems are in use.

Allegheny, Pa.—The new city lighting plant in Allegheny may remain unused until the 17th of July. An effort is being made to have the council postpone the formal inauguration of the plant until that date, at which time will be held the celebration of the semi-centennial of the city's life. The residents of the city look forward to a glorious time on that occasion, and think it would be fitting to then for the first time illuminate the highways and byways of the town with the new system of electric lighting.

APPLICATIONS OF POWER.

Detroit, Mich.—The Detroit Motor Company has increased its capital stock from $200,000 to $300,000.

Austin, Tex.—An electric power plant will be established at once by the Austin and Gravis County Rapid Transit Company.

In Alabama they are talking of connecting the towns of Florence, Sheffield and Tuscumbia by electric railway. It is stated that Kansas City capital will be interested in the project.

The railway department of the Westinghouse Electric Company is now represented at Pittsburg by Mr. H. McL. Harding, at Chicago by Mr. J. L. Barclay, and at New York by Mr. C. C. Warren.

Augusta, Ga.—The new electric street railway, in order to be ready to handle big crowds of people attending the State military encampment near that city, has done a great deal of rapid construction work.

Athol, Mass.—It is reported that business men at Athol are beginning to think that the electric street railway will never materialize. The Dunham & Brown combination has a year in which to build the road before the franchise is void.

Columbus, O.—New tracks are being laid on West Broad street for the electric cars, and the work of connecting the rails is being done as fast as the tracks are laid. It is not expected that cars will be running before two months at least.

Prof. Thomson's "Baby" Motor, which was exhibited last year at the Paris Exposition and now used in connection with the phonograph in his office, works with perfect success. It is five inches long, two inches high, and two and a half broad at the base.

Spokane Falls, Wash.—There is a sharp contest between the Spokane Street Railway Company and the City Park Transit Company, both wanting to lay tracks on Division street for an electric and cable line. Both sides are awaiting the action of the court to which the case has been referred.

Will Manufacture Electric Motors.—The recently organized Wenstrom Consolidated Dynamo and Motor Company, of Baltimore, Md., has purchased a 12 acre site at Calverton, Md., and will erect a two-story building 100 x 250 feet, that is to cost $100,000. The company proposes to give employment to 600 men.

Charleston, S. C.—There are rumors to the effect that the same syndicate that recently acquired control of the street railroads of Savannah, Ga., with a view of converting them into electric lines, is negotiating at Charleston, S. C., through representatives looking to a similar absorption of street railway interests.

Chicago, Ill.—Permits were granted last week by the municipal authorities for the construction of the Cicero and Proviso Electric Railway, and the work of construction has already been begun. The brick work of the power house at Ridgeland has been completed, and materials for the electrical equipment of the system are arriving daily.

Louisville, Ky.—The two street railway lines have been sold to a syndicate of Eastern capitalists, who made the first payment and took formal possession last week. E. E. Deniston, of the banking firm of E. A. Clarke & Co., Philadelphia, is representing the syndicate, which includes J. W. Seligman & Co., New York; Kidder, Peabody & Co., New York; Brown Brothers & Co., New York; the First National Bank of Philadelphia; the Fidelity Insurance and Safety Vault Company of Philadelphia, and others. The first payment was $800,000.

Randolph, Mass.—A meeting in the interest of electric lighting and street railroads was held last week, at which W. A. Stiles and W. B. Ferguson, of the Thomson-Houston Electric Company, were present. It is proposed to start at the West Corners in Randolph and proceed to Avon, thence to Main street, Brockton, and possibly connect with the East Side Electric Road in Brockton, making a distance of about 10 miles. A paper for the subscription to stock will be opened at once in Randolph, Avon and Brockton, and as soon as the franchise can be obtained work will be begun.

An Electrical Tricycle Wanted.—Commenting on our recent editorial on "Electrical Road Vehicles," Mr. Chas. H. Avery, superintendent of the Geneva Brush Electric Light and Power Company, of Geneva, N. Y., says: "I have often wished for an electrical tricycle, as I could make it very useful for lamp inspection on street circuits and replace a defective lamp on very short notice, or it would be very useful in hunting 'breaks,' as I have about a 20-mile street circuit, and if we have a break in the afternoon it necessitates horse and hack (as I have to take a lineman and tools with me), in order to find it previous to that night's run. I could make an electrical tricycle that would carry two persons

very useful in a great many ways in connection with an electric light station and something more than a lazy man's delight.'"

Pittsburg, Pa.—President Dalzell, of the Pittsburg, Allegheny & Manchester electric railway, says the work of constructing the new line will be started within a week and that it will be pushed forward to completion with all possible haste. The start will be made on the Western avenue branch. No decision has as yet been made with regard to the kind of motor to be employed but it is said that a majority of the directors favor the Thomson-Houston motor. The loop at the Pittsburg end will be formed by an extension of the tracks along Market street to Water, thence to Wood street, thence to Liberty street, and thence along that thoroughfare to the present terminus of the main line. This arrangement will be of decided advantage to many business men who reside in Allegheny and transact business along the route to be traversed by the new loop.

An Eight Wheel Electric Car.—A trial trip was made last week on the tracks of the West End street railway in Boston, Mass., of a car which possesses quite a number of striking and novel features. It was built by the Newburyport Car Manufacturing Company, at Newburyport, Mass., and is 28 feet long from door to door, 7 feet 3 inches wide, 7 feet 9 inches in height inside, and has a seating capacity of 46 passengers, 23 on each side, more than double the seats in a common box car. The seats are luxuriously cushioned, and at night the car is lighted by a half-score of incandescent lamps. The car is mounted on two trucks, one at each end, and each truck has four 30-inch steel wheels, and one 15 h. p. Thomson-Houston motor. The car is provided not only with the common hand brake, but also a vacuum brake, and it is possible to stop very quickly, even when going at high speed. The Tripp anti-friction bearings are used throughout, and the trucks are of an entirely new design (on which patents are pending), the equalizing bar being connected to the journal boxes underneath, instead of passing around the top as usual. The car is also provided with the Jewett frictionless car centres, which carry the weight of the car on frictionless rollers that move with the slightest strain, permitting the car to adjust itself to the movement of the trucks. By invitation of the Tripp Manufacturing Company, quite a party of gentlemen had the pleasure of riding on the new car. The test was satisfactory in nearly every respect, and the large car attracted much attention from hundreds of people who chanced to see it on its trial trip.

A Four Hundred Horse Power Motor Plant.—The Mather Electric Company of Manchester, Conn., has just closed through its New England agents, Messrs. Claflin & Kimball of Boston, an important contract for an electric power plant. The plant will be used to run a large part of the Cumberland and Presumscot paper mills belonging to the firm of S. D. Warren & Company of Boston. These mills, which are the largest paper mills in the world, are situated on the Presumpscot River, about four miles from Portland, Me. About 1¼ miles above the mill there is a large water power belonging to the same company, which the firm has for a long time wished to utilize in some way at its mills, but up to the present time has been unable to do so. At the falls in the river will be placed the generating station where there will be five generators capable of delivering 80 horse power each, thus having a combined capacity to deliver 400 horse power; this power will then be transmitted to the mill, 1¼ miles below, and there distributed throughout the mill, driving motors of 40 h. p. capacity each. The motors will drive isolated machines or lines of shafting as the case may be. In general these motors will have to run from 6 o'clock on Monday morning to 6 o'clock on Saturday night, night and day without a stop. The contract was awarded to the Mather Electric Company, it is said, after a long, and it may well be imagined sharp contest; the electric apparatus of all the large companies was carefully investigated by electrical engineers in the interest of Messrs. S. D. Warren & Co., and the award was made upon the very high reputation possessed by the electrical machinery manufactured by the Mather Electric Company.

MISCELLANEOUS NOTES.

Lynn, Mass.—Professor Thomson has just patented a system of electrical distribution, which is a combination of his compensator system with the transformer system, so that a high potential—1,000 volts, more or less—may be carried any distance and reduced to a much smaller voltage, effecting a great saving in copper.

The Kemmler Case Again.—When the appeal in the Kemmler case came before the Court of Appeals at Saratoga, N. Y., the decision of the lower court was affirmed. So far as the courts are concerned this is the last of the Kemmler case and the sentence must now be carried out as originally imposed by the lower court. The time for the execution has not yet been chosen.

Detroit, Mich.—An explosion of natural gas occurred in an electric conduit manhole at the corner of Jefferson avenue and Griswold street on the 16th ult., seriously injuring Morris Marks, a lineman in the employ of the Detroit Electric Light and Power Company, who went into the manhole carrying a lighted torch. The gas had evidently leaked from a neighboring gas main.

At Cornell University this year high grade thesis work was done in the electrical engineering department by Calvin Humphrey, A. B., upon "A Study of the Magnetization of Powdered Iron in Connection with the Alternate Current Transformer;" by A. B. Levy, B. S., upon "Arc Light Carbons," and by L. B. Marks, B. S., M. E., upon "The Effects of Heating the Core of the Converter."

The American Society of Civil Engineers, in session last week at Cresson Springs, on the crest of the Allegheny Mountains, discussed the comparative cost of electricity and steam for railroad service. Lincoln Moss read a paper which is said to have contained a statement of certain facts, upon which he based his estimate that the cost of direct electric propulsion would amount to four times that of steam locomotion.

Cavendish Laboratory Scholarship.—The amount bequeathed to the University of Cambridge by Mrs. Clerk-Maxwell to found a scholarship in the Cavendish Laboratory at Cambridge is now available and amounts to £5,963, with accruing interest on the sum of £5,000, on deposit with the National Bank of Scotland The scholarship will be founded for the encouragement of original research in experimental physics, and especially in electricity, magnetism and heat.

A Course in Electrical Engineering is projected at the Western University of Pennsylvania at Allegheny. This course, which will begin with the junior year, is designed to meet the wants of the student desirous of making profitable use of his knowledge, in the commercial sense, and to offer facilities of a suitable character for the study of the subject of physics, for its own sake. In the senior year most of the time will be given to applied electricity in connection with subjects from the course in mechanical engineering having relation to the practical superintendence of electrical works.

The Fourth of July has lost its terrors to de nisens of the city or country who follow carefully the directions of Mr. Eugene F. Phillips, of the American Electrical Works, Providence, R. I. Mr. Phillips' patriotism and sympathetic feelings for his fellow sufferers on Independence Day have prompted him to send to his friends a simple device by the use of which "the cannon's roar is hushed." The directions for use say: "At 11 55 o'clock, July 3, insert the red cork in your right ear; allow the white string to repose quietly on your neck; place the blue cork in your left ear, and, decorated with these emblems of patriotism, enjoy a peaceful Fourth of July slumber from 12 to 7 A. M., and credit the same to our account." It should be understood that ordinary corks will not answer the purpose, but these specially-made corks are the only ones that will have the effect which Mr. Phillips desires his friends to experience.

The Electric Mining Machine is an assured success in the Pittsburgh, Pa., district. At the Summerhill mines of Thos. Armstrong, Woodville station, a short distance from the city, on the Panhandle road, five of the machines are used at present. It is the Hercules mining machine which has been adopted in connection with the Tesla motor. Owing to the scarcity of miners in the district, it is likely several other mines will be similarly equipped. The Summerhill mine is to have incandescent lights, to the end that explosions may be prevented. The Mill and Mine Electric Equipment Company is now putting in new mining machines at the works of the Monongahela Gas Coal Company, in the first pool of the Monongahela River.

The Phonograph Two Hundred Years Ago.—The *Baltimore American* points out that Shakespeare's Ariel had as good, if not as practical, an idea of the telegraph as Prof. Morse, and that Edison must share the honor of the phonograph's conception with one of Dryden's contemporaries. This was Thomas Ward, a theological poet, who was born in 1640 and died in 1704. In the second canto of one of his poems occur these words:

"As Walchius could words imprison
In hollow canes, so they, by reason,
Judgment and great dexterity,
Can bottle words as well as he;
And can from place to place convey them,
Till, when they please, the *reed* shall say them;
Will suddenly the same discharge,
And hail-shot syllables at large
Will fly intelligibly out
Into the ears of all about;
So that the *auditors* may gain
Their meaning from the breach of cane."

The International Okonite Company, Limited, has been incorporated in England with a capital of £340,000, divided into 17,000 preference and 17,000 ordinary shares of £10 each. The company is organized for the manufacture of insulated telegraph, telephone and other electric wires and cables. The preference shares are entitled to eight per cent. dividend, payable half yearly, and to a bonus of two per cent. additional out of a surplus profit of every year after the ordinary shares receive 15 per cent. dividend. From the remaining profits the ordinary shares will then be entitled to a bonus of five per cent. The directors of the new company are: Lord Grenville, Samuel Pope, Major Jones, Sir Alexander Armstrong and Harry Dobree, in England, and in America, John H. Cheever of the New York Belting and Packing Company, John L. Martin, of the Southern & Western Air Line Railroad, and H. Durant Cheever, F. Cazenove Jones and W. L. Candee, of the Okonite Company, New York. The consulting engineers are Sir William Thomson and Dr. John Hopkinson. The object of the company is stated to be to acquire the highly successful business of the Okonite Company in New York, and to extend the same to all parts of the world. The business is to be taken over from Jan. 1, 1890. The factories will be at Newton Heath, Manchester, England, and at Passaic, N. J., with offices at 34 Cannon street, E. C., London, and 13 Park Row, New York. The promoters of the company are Messrs. Woodhouse & Rawson, London, who sent their managing director, Mr. F. L. Rawson, to the United States to secure information concerning the conduct of the business. The report which he made on his return from England respecting the successful character of the Okonite Company's affairs in America, led to the acquisition and organization of the business as here announced. The books for the subscription of a specified number of shares of the new company's stock were opened simultaneously in London and New York on Tuesday of this week, and remained open only one day, closing at 12 o'clock on Wednesday. The great success of the Okonite wires and cables in commercial service in this country, indicates that the broader field over which the company is now to extend its business will bring increased profits and even greater successes than have heretofore been experienced by this company.

PERSONALS.

Mr. Marsden J. Perry, of Providence, R. I., president of the National Electric Light Association, was a visitor to Pittsburg last week. He spent considerable time examining the electric railways and the shops of the Westinghouse Electric Company.

Mr. Samuel S. Sias, treasurer of the Boston Electric Light Company, and Mrs. Sias celebrated the twenty-fifth anniversary of their marriage at their residence in North Cambridge, Mass., Saturday evening, June 21. Over 250 guests attended the reception, and many elegant gifts were received by Mr. and Mrs. Sias.

Mr. Frank A. Perret, of the Elektron Manufacturing Company, Brooklyn, N. Y., has just returned from a trip to Iowa, bringing with him an order for seven 15 h. p. Perret motors to be used in coal mining. Some of these will be combined with undercutting machines, taking the place of compressed air apparatus used heretofore.

Mr. Elmer P. Willyoung, electrician of the firm of Queen & Co., Philadelphia, Pa., was a caller at the New York office of THE ELECTRICAL WORLD one day last week. His success in business keeps him in good spirits. One of the latest orders he has captured is for a complete outfit of insulation testing apparatus for the new works of the India Rubber and Gutta Percha Insulating Company.

Mr. H. M. Byllesby, vice-president and general manager of the Westinghouse Electric Company, sailed for England on the "Teutonic," June 25, where he expects to be occupied for some time with the affairs of the Westinghouse Electric Company, Limited, of London. This corporation has control of the patents of the Westinghouse Electric Company for the entire world, with the exception of North and South America. Mr. Byllesby is managing director of the English company.

Mr. P. T. Kenny, formerly traveling salesman in New England for the lamp department of the United Edison Manufacturing Company, was in this city last week on business and found time for a pleasant call at our office. Mr. Kenny's thorough and faithful work for the company he has represented has been rewarded by a promotion to a much wider field of labor, as general traveling salesman for the United Edison Company, of Canada, with headquarters in Toronto. His many friends in this part of the country will join with us in wishing him in his new territory the abundant success he so well deserves.

Industrial and Trade Notes.

Mr. J. D. Renz, 327 Minnesota street, St. Paul, is having excellent success in introducing the Perret motor in that city.

R. P. Smith, of the Connecticut Motor Company, reports the sale of two 10 h. p. motors, one 7½ h. p. and one 5 h. p. during the past week.

The New England Electric Company, of Boston, agent fyr the Sprague Electric Railway and Motor Company in New England, is doing a rushing trade in small motors.

The North American Construction Company, of Pittsburgh, is a very busy concern. It has just about completed the installation of the Allegheny City lighting plant, and has on hand a number of contracts of equal magnitude.

The National Engineering Bureau, 331 The Rookery, Chicago, is keeping its office force busy of late in writing up specifications for various architects. It is also carrying on a series of tests of insulated wires manufactured for concealed wiring.

The B. S. Hale & Son Corporation, of Malden, Mass., is very busy filling heavy orders for magnet wire, etc. This company removed a short time since to its present quarters, so as to have more room, but its business has grown so that the addition of extra facilities is contemplated.

The Hine Eliminator Company is in receipt of the following testimonial from the Gilliland Electric Company, of Adrian, Mich., under date of June 21: "The vertical eliminator we purchased of you last February gives the very best satisfaction, and you can refer any one to us in regard to its working."

"Machine Telegraphy of To-day" is the title of a monthly pamphlet issued by the American Machine Telegraph Company, 5 and 7 Dey street, New York, which gives a great amount of information as to the comparative advantages of machine telegraphy and the ordinary "Morse" systems. The capabilities of the machine telegraph are clearly and concisely pointed out.

Mr. C. E. Sargent, manager of the Chicago office of A. L. Ide & Son, 89 Lake street, has placed a 100 h. p. Ideal engine in the South Side cable railway station, a 45 h. p. Ideal in J. A. Fay & Co.'s Canal street warehouse, a 45 h. p. Ideal with H. W. King & Co., St. Paul, and a 45 h. p. Ideal with the Minonk Electric Light and Power Company, in addition to several other sales.

The Electric Merchandise Company, 11 Adams street, Chicago, is gaining an enviable reputation for prompt deliveries of its specialty—electric street railway material of all descriptions—and many superintendents are expressing their gratification over the fact that they can now secure whatever may be desired, whether a set of gearing or a single carbon brush, on telegraphic notice.

The Illinois Electrical Material Company, 341 The Rookery, Chicago, has already found it necessary to secure additional store room and office room owing to the amount of business which its friends are sending in. Especially in the line of heavy construction material has there been a constant demand, and shipments of poles—of which it has an abundant stock—are of daily occurrence.

The Tyer Rubber Company, of Andover, Mass., is making an especially coated pure gum tape that adheres more readily than ordinary tape, and has many other good qualities. Another article of this company's manufacture that is worthy of especial notice is the "Niotus" tubing, which is very strong and flexible and of a very soft grade. Some flattering orders have lately been received from electrical companies.

Conover & Company's improved belt power air pump and condenser, manufactured by this firm at 95 Liberty street, New York city, is meeting with great success in its adaptation to high-speed compound engines, and especially in its application to engines now in use where a saving in fuel or an increase in power is desired. The air pump is driven directly from the main engine or by means of a countershaft as is most convenient.

The New England Wiring and Construction Company, of Boston, Mass., is making the following installations: a 1,000-light Thomson-Houston incandescent plant at Bonema Mills; an Edison municipal plant at Groveton, N. H.; in Dr. Burgreins' dwelling house, Lynn, Mass.; in a large dwelling house at South Framingham, Mass., for Fales & Sons, contractors, and in numerous other dwellings in Boston and vicinity.

The Lane & Bodley Company, of Cincinnati, O., has this week closed contracts with the Cincinnati Street Railway Company for two 28 × 60 and one 24 × 60 Corliss engine; also has sold a 22 × 48 to the Henry Pearce's Sons Cotton Works, an 18 × 42 to the Walworth Electric Company, of Boston, Mass., and a 20 × 48 Corliss engine for the Main Street Electric Railway Company, Cincinnati, O., operated by the Cincinnati Incline Plane Company.

The Pettingell-Andrews Company, of Boston, Mass. has received during the past week orders for over 50,000 K. W. cut-out rosettes. This is in addition to very heavy orders from all parts of the country for their other porcelain goods and electric supplies of all kinds, including large sales of Okonite wire. It is truly marvelous how the business of this enterprising firm has been built up, and shows great push and energy on the part of the proprietors.

The Novelty Pocket Screw-driver is especially adapted to the needs of electric light linemen and incandescent light and other wiremen who desire a neat and convenient pocket tool. The blade is made to project when in use, and can be released and pressed backward into the handle when not in use. The frame is of cast bronze metal, the sides of cocoa or ebony wood, and the blade of steel. It is supplied to the trade by The E. S. Greeley & Co., 5 and 7 Dey street, New York city.

The Essick Printing Telegraph Company is meeting with great success in the installation and operation of its ingenious instruments. Sub-companies are being formed and the work of building new lines on which to operate the company's system will be pushed as rapidly as possible. Recent tests between Boston and New York and Washington and New York have demonstrated the practicability of the invention and the extreme simplicity of its operation. It makes a success of "bringing telegraphy back into the American language."

George W. LaRue now represents the Sprague Electric Railway and Motor Company in New York and vicinity as the successor of P. A. Dowd & Co., at 239 Broadway. He reports a booming business, better than he has ever known in the motor industry. He has recently been putting in some large ventilating plants, among them being Dennett's restaurants in New York and Brooklyn, Dixon's ice cream manufactory and the Niagara Insurance Company's office, and has in course of construction several electrical equipments for elevators.

The Interior Conduit and Insulation Company is now equipping two large buildings in Philadelphia with its system of interior conduits. One of these is the large new apartment house of Mr. W. G. Warden, northwest corner of Pine and Eleventh streets, for 2,500 incandescent lights, in which about 50,000 feet of tubing will be used, and is now being put in by the Germantown Electric Light Company, and the other is a seven-story building, between

Fifth and Sixth streets, on Market street, for about 150 lights, and the work is now being done by the Raymond Electric Company.

Ayrton & Perry's Magnifying Spring Ammeters and Voltmeters are meeting with deserved success in this country. The stock of these instruments kept on hand by their agents, Messrs. Queen & Company, of Philadelphia, has been largely increased, so that orders for those of ordinary range may be filled without delay. The chief features of the Ayrton & Perry instruments—portability, freedom from magnets, and the direct reading scales—adapt them to very general use in various kinds of electrical work. Many of them are now in use in electric railway plants.

The Cobb Vulcanite Wire Company, of Wilmington, Del., has just closed two very large contracts for electric light wire, one in Chicago and one in Minneapolis. The Chicago contract is for 167,000 feet of No. 5 arc light cable for street lighting and subway work. Over 400,000 feet of cable will be required to fill the Minneapolis contract. This cable will be used in placing the entire arc and incandescent system of the Minnesota Brush Electric Company underground. These contracts are for the Cobb company s new patent subway cable, and are a very substantial recognition of its merits.

The Consolidated Temperature Controlling Company, of Minneapolis, Minn., through its general agent, Howard F. Jones, of Henderson, N. C., has been successfully introducing its heat regulator among the tobacco warehouse men in the Carolinas. With the aid of this device tobacco "curing" is not only simplified, but the weed is uniformly and sweetly cured, while all danger of scorching and loss of aroma is avoided. By this means each change of a single degree is noted, and should the temperature fall too low at night an alarm bell awakens the attendant in time to add the necessary fuel.

The Wright Electrical Engineering Company, of Boston, Mass., is doing 15 miles of line construction and installing 130 additional series lamps at Hingham and East Weymouth, Mass., for the Weymouth Electric Light and Power Company. This company is installing 44 lights in the dining room of the American House, Boston, and has just finished the installation for the Pawtucket Club, at Pawtucket, R. I. At Meriden, Conn., it has already installed over 1,000 lights in the leading banks and business blocks, and, taken altogether, this company is now enjoying a well-deserved business success.

N. Shaw & Co., proprietors of the Eagle Iron Works, at Eau Claire, Wis., are about placing on the market an improved clutch pulley. The locking or intermediate lever terminates in a projecting toe which bears against a steel pin, inclosed in a socket fast to the lower lever, this pin being adjustable by means of set screws. When the members begin to clutch the rim, the motion is a rolling one, making the clutch one of the most powerful in the market. A self-oiling sleeve is fitted to all of their pulleys, holding from one pint to one-half gallon of oil without waste, and will run three months with one filling.

The Hall Signal Company, whose system of railroad signals is extensively described and illustrated elsewhere in this issue, is thus referred to by Mr. George W. Blodgett, the electrical engineer of the Boston & Albany railroad: "It is not known that a train has ever been stopped by one of these signals except for a legitimate cause " After referring to the excellent record which it has made in actual service, he says: "This record of efficiency is far ahead of any other system of signals with which I have had experience." And again : "The cost of maintenance is very small, amounting principally to the consumption of blue vitriol and zinc in ten cells of gravity battery."

Electric Lights from Gas.—More than one instance might be cited in which the substitution of gas engines as the motive power of an electric light station has resulted in the production of a very satisfactory degree of increased economy. At Atlantic City, N. J., Mr. Joseph Barstow, the president of the gas company in whose electric light plant gas engines have partially displaced the steam engines as a motive power for the dynamos, is much elated over the success of the enterprise. A 50 h. p. "Otto" gas engine has been installed in the works, and its operation is pronounced about as nearly perfect as it can be. The arc lighting system in use is the Thomson-Houston with about 100 full arcs in circuit.

The Tools for Electrical Manufacturers which the American Saw Company, of Trenton, N. J , is offering to its patrons, are fitted with a new style of bearing which is practically self-lubricating. Each bearing is furnished with a perforated sleeve or metallic lubricator fitted to the spindle, making the use of a fluid oil almost unnecessary. For emery wheel and high speed lathe bearings, this style of lubricator has proved a great success. After using a buffing machine fitted with these bearings for two months, the Hall Safe & Lock Company, of Cincinnati, Ohio, says of it: "One oil cup full of oil has kept the bearings perfectly cool for this length of time with enough oil left to run for a couple of weeks longer."

The Wilmot & Hobbs Manufacturing Company, of Bridgeport, Conn., makes a specialty of sheet metal manufactured goods, and has now in operation a finely equipped plant. It operates its own rolling mills, and has its own nickel and brass plating departments, and is ready to take very large contracts for goods of this character. The company has lately taken some large orders for electrical work, one of its novelties being the "Rustless" bell steel gong. These gongs are manufactured from a special grade of metal used only by this company, by which the bells are given a remarkable clearness of tone, while the "rustless" quality is imparted by the use of a secret progress. One of these bell gongs, after being exposed in an open field for five days in rainy weather, still retained its bright finish.

The Sessions Foundry Company, of Bristol, Conn., has recently added to its foundry a brick molding room about 80 x 45 feet, with an ell 30 x 50 feet for cleaning room, cupola room, etc. A large new cupola has also been added, and the company contemplates putting in a power traveling crane. Instead of 35 tons of metal a day run from three large cupolas, this will give the company a capacity of 50 tons per day. The company is turning out a great many dynamo magnet castings as well as doing a good business in supplying smaller castings of a great variety of styles and patterns. The company's trade is constantly growing, and these additions to its foundry have been made in order that it may keep pace with the increasing demand for all kinds of castings.

The Law Telephone Company, 85 John street, New York city, has issued three neat little pamphlets, each of which sets forth the merits of the improved double cylinder Law battery as applied to a particular use. One points out the principal features which fit this excellent battery for use in gas lighting, burglar alarm, bell and annunciator work; another treats of its adaptability to telephone work; while the third indicates why it has become so popular with physicians as a medical battery. In each of the pamphlets is given a number of very flattering recommendations from users in the three classes of work, and all alike contain price lists, illustrations of the apparatus, descriptions of the cell and its construction and directions for setting it up and maintaining it in the very best condition.

The Elektron Manufacturing Company of Brooklyn N. Y., has performed a real service to the users of small electric motors in the publication of a pamphlet containing a fund of information relating to battery motors and batteries and their applications. This little pamphlet will prove useful to thousands of people who are operating small electric plants, and who have been seeking for information upon these subjects written in a style sufficiently simple to be easily understood. Illustrations are also given showing some of the most important uses to which small motors are put. The company has found the demand for motors of its low speed type to be constantly increasing, and has, on this account, been compelled to enlarge its works and take an additional floor in the factory building it now occupies. This will give the company splendid facilities for handling its prosperous business.

The Thomson-Houston Motor Company, of Boston, Mass., of which Mr. H. C. Spaulding is the general manager, has issued a little pamphlet setting forth very plainly, by means of well executed illustrations and clear descriptions, some of the various uses to which the Thomson-Houston stationary motor has been applied, such as the driving of printing machinery, the operation of shoe factories, machine shops, and in similar classes of work. The tables giving the weight, dimensions, speeds, belt speeds, horse-power, etc., of the various sizes of motor from one to 75 horse-power contain just such information as is often sought by intending purchasers of motors, and will be found very useful. Under Mr. Spaulding's management the Thomson-Houston motors, which embody the results of careful work by both Professor Thomson and Mr. E. W. Rice, have had a wide sale for use in almost every branch of the manufacturing industries.

The Knapp Electrical Works, 54 & 56 Franklin street, Chicago, have already booked many orders for their Diamond K combination switch and fuse box, and there is every indication that it will come into practical use on every alternating current circuit in the country, as the employment of this switch does away with the necessity for climbing high poles to renew the fuses in a converter as at present, for this device can be located low down on the pole and suitably connected by merely extending the primary connecting wires. Again it permits of placing the converter in positions heretofore deemed inconvenient for everyday work, and to a large extent will do away with the placing of converters on buildings in positions that often mar the general appearance of the structure, and all this with only the slight additional cost of the extra length of wire required for connections.

A Handsome Pamphlet has been issued by the C. & C. Motor Company, 402 and 404 Greenwich street, New York city, which is entirely occupied with illustrations and descriptive matter relating to the application of the electric motor to organ blowing. Very fine illustrations are given of the C. & C. electric motors as used for this purpose in St. Paul's Chapel, Trinity Church, and the Church of the Holy Communion, all in New York city. A table containing a list of 14 C. & C. motors used for organ blowing in New York city alone, ranging from one-eighth to three h. p., contains valuable information as to the power necessary for this class of work for which great numbers of the C. & C. motors are now employed. Fac similes of letters received by the company from organists testifying to the success of the C. & C. motor in various large churches in New York city and elsewhere form an interesting and unique feature of this really elegant little pamphlet.

The Consolidated Electric Storage Company, manufacturer of the Julien storage battery and exclusive licensee for the United States of the storage battery patents of Charles F. Brush, has also acquired United States patents Nos. 383,757 and 408,986 of Henry G. Morris and Pedro G. Salom. These patents cover a machine known as the mechanical filler, by which the work of applying the active matter to the "conducting support" is performed. The machine is said to dispense with the labor of from 30 to 40 men. The company has issued an important circular, setting forth in plain terms the claims made by it to the control of the successful manufacture of storage batteries in the United States. All orders and inquiries concerning batteries should be addressed to 926 Drexel Building, Philadelphia, Pa. The capital stock of the company is $3,000,000, divided into shares of $25 each.

The Electro-Pneumatic Time Company, 45 Broadway, N. Y., has placed in the Aldrich Court building, in which its office is located, a complete plant of its new system for the distribution of standard time. This system has been developed by Mr. C. A. Mayrhofer, of Vienna, Austria, and is adapted to the distribution of time in large office buildings, exchanges, railway stations, hospitals, club houses and similar buildings. It has been successfully introduced into a number of public buildings in Vienna, and into the new stock exchange, the Potsdam railway stations, the Urania and other buildings in Berlin. The advantages claimed for this system are that any number of clocks up to 500 can be operated from one central apparatus; that no winding of the master clock is necessary; that the secondary clocks are absolutely and reliably kept in synchronism with the master clock, and are wound up by the central apparatus; that accidents to the connecting pipes do not interrupt the service; and that tower clocks may be included in the system. The system is operated automatically by the joint action of electric, hydraulic and pneumatic forces.

The John Stephenson Company, Ltd., 47 East Twenty-seventh street, New York city, is enjoying a prosperous business. Its shops are fully occupied in filling orders for cars for the various systems of traction, not a few of them being for electric street railways. General Slocum has ordered additional trail cars for the Coney Island and Brooklyn Railroad. Cars are in process of construction for the Georgetown and Tenallytown Railroad, Georgetown, D. C. The first installment of cars has been shipped to the Metropolitan Electric Railroad Company, Butte City, Mont. Cars are being delivered to the new road at Huntington, L. I. The Detroit Motor Company has just completed the equipment of the new Stephenson storage battery car (Pumpelly system), and has shipped it to Middlesborough, Ky. Stephenson cars are to be used on the new electric road that is to connect the villages of Flushing and College Point. Additional orders have been received from Spokane Falls, Wash., and at Covington, Ky., the "Short" electric system will be equipped with Stephenson cars. Orders continue to come in from the City of Mexico, Valencia, Spain, Caraccas, Venezuela and other foreign cities.

The Interior Conduit and Insulation Company, of New York city, is now making car-load shipments of tube daily throughout the country. The new underground tube seems to be giving a great deal of satisfaction. This company has a contract for furnishing the underground conduits for St. Paul and Minneapolis, and has also sold several thousand feet to the Pennsylvania Railroad Company for its underground work. A large shipment has been made to Japan, and a shipment will probably be made to Germany during the coming week. The company's new and commodious quarters enable it to turn out tubes in large quantities, although it has not as yet succeeded in catching up with the orders; but it is probable that this will be done before the middle of the coming month, as the output has been increased tenfold. The initial job of this company, the Shorham apartment house, Washington, D. C., owned by the Hon. L. P. Morton, has now been in operation about eight months and has never given any trouble since the plant was turned over to the purchaser. That it is an unqualified success is evidenced by the fact that Mr. Morton is now preparing to build an extension of the Shorham House, and it is specified by the architects throughout the entire new building.

The Firm of McIntosh, Seymour & Co., of Auburn, N. Y., continues to sell a very large number of compound and other engines. They have orders on hand now for a 450 h. p. double tandem compound condensing engine for the Thomson-Houston plant in Memphis, Tenn; one 250 h. p. compound engine, one 200 h. p. compound engine, and one 150 h. p. compound engine for the Wisconsin Central Railroad Company, for its new depot at Chicago; one 150 h. p. and two 200 h. p. compound engines to run with 130 pounds steam for the Chicago Edison Company; two 150 h. p. compound engines to run with 130 pounds pressure for the Thomson-Houston plant in Hyde Park, Ill.; one 150 h. p. and one 100 h. p. compound engine for an electric plant in Kingston, Jamaica; two 150 h. p. compound engines for the St. Johns Street Railway Company, St. Johns, New Brunswick; one 100 h. p. compound engine for electric lighting in Phillipsburg, Mont.; one 100 h. p. compound engine for the Miles City Electric Lighting Company, Miles City, Mont.; one 100 h. p. compound engine for an electric light plant in Mexico; three 200 h. p. standard engines for the Chicago Edison Company, Chicago, Ill.; one 90 h. p. standard engine for J. E. Cornell and one 65 h. p. standard engine for W. L. Githens, both of which engines will be used in the Hyde Park hotel, Hyde Park, Ill ; one 90 h. p. standard engine for the Nantucket Electric Light Company, Nantucket, Mass.; one 30 h. p. standard horizontal engine for Hallett & Cumston, Boston, Mass. This firm now has very large works, fitted all the way through with some of the finest machinery in the United States. A short time ago the company commenced running its large new foundry, which is capable of turning out fifteen tons of castings a day. This is one of the largest and best equipped foundries for making engine castings in the State of New York. It is equipped with a large power traveling crane, Colliau furnaces, and all other apparatus which can in any way assist in making fine castings at a reasonable cost.

Answers to Correspondents.

Questions to be answered in this column must be of general electrical interest. All inquiries must be accompanied by real name and address, as a guarantee of good faith. No notice will be taken of questions regarding apparatus unless enough details are given to permit a definite answer, and no dynamo or motor designing will be done.

Motor Resistances.—Will you kindly inform me through the columns of your paper what the resistance of a field magnet coil and armature of 110 volt, ½ horse power motor, shunt wound should be? What is meant by the current strength of an alternating current? CONSTANT READER.

1. The armature and field resistance of a motor is almost entirely a matter of the individual design used. The resistance of the shunt is many times that of the armature to secure economy. Consult some work like Thompson's "Dynamo-Electric Machinery." 2. The current strength of an alternating current is generally taken as the square root of the mean square of the plus and minus currents.

Primary Battery Lighting.—Is incandescent electric lighting by battery being successfully carried on? Which is the best system and which is the best battery for the purpose, apart from other considerations? C. M. T.

Incandescent electric lighting by battery is only moderately successful on account of its cost and the trouble of taking care of the batteries. On a small scale it is sometimes convenient, but wherever practical the secondary battery is probably cheaper and less troublesome than any primary battery. Of these latter used for such a purpose there are many for which various claims are made. The Mason or the Edison-Lalande battery, both of which you will find advertised in our columns, probably are as cheap and require as little care as any.

Storage Batteries on Arc Circuits.—Please inform me through your columns whether or not the storage battery is applicable and profitable to place in arc light circuits so that the battery can receive the surplus current and be made to return it when needed. I am aware that it is asserted that a secondary battery can be so used, but would like to know the facts in the case. O. R. C.

The secondary battery can be successfully applied in the way you mention, but the economy of the process and the profit to be derived from it would depend too much on the individual circumstances of your plant for us to advise you intelligently concerning its adoption.

Motors for Amateurs.—Would you please inform a reader of your paper on the following subjects: (1) What is the diameter of No. 18 B. & S. gauge double cotton-wound magnet wire? (2) Can common cast iron be used for field magnets with small machines? (3) Which is easier for an amateur to construct, a series or a shunt wound machine? A. S.

(1) The diameter of No. 18 B. & S. bare wire is 40 mils. The diameter over cotton insulation varies with the make of wire; 10 or 12 mils would be the approximate amount. If you desire the exact figure the only way is to measure the particular sample of wire that you are going to use. (2) Common cast iron makes very poor field magnets; in a small machine it would be better to use forgings. (3) A series machine is rather easier to construct than a shunt machine.

The Carbon Brush.—In your issue of May 17 mention is made of the carbon brush now in general use on electric street railways. Am I to understand by this that the carbon brush is simply used on the motors of street railways, or is it generally introduced for electric lighting purposes as well? There would seem to be very serious objections to using brushes of this kind owing to a deposit of carbon between the segments of the commutator, thus destroying the insulation and causing the machine to heat. I have made some protest against using them on a 1,000-volt Edison machine, and would like to know if my opinion is endorsed by good authority. C. H. M.

The carbon brush has given very excellent results in use on dynamos for lighting and power purposes. It is at present used in many railway power stations and with uniform success. There is the deposit of carbon between the commutator segments of which you speak, but it does not become serious unless the commutator is neglected in a reprehensible manner. With ordinary care and cleanliness the carbon brush will work admirably on machines of as high potential as 500 volts. It is possible that on the municipal machine of which you speak its use might be more difficult owing to the high potential, but a very brief trial would soon show the extent of the difficulty without serious danger of injuring the machine. The carbon brush used should preferably be copper plate and is sure to lessen the somewhat high resistance. When first put in it is liable to spark a little from the fact that its contact surface does not fit the armature wheel. This can be remedied by binding a strip of fine sandpaper around the commutator when the machine is not otherwise in use, putting the brushes into their holes and letting them

face themselves against the revolving sandpaper. They can then be put on the commutator with no danger of perceptible sparking. Care should be taken, however, that the contact surface of the brush is not wide compared with the width of a commutator segment. It should be of about the same width as the contact surface on the copper brush previously used.

Measurements.—(1) What is meant by a brake h. p.? (2) Are not meters made to measure alternating currents? (3) If so, are these put into primary or secondary coil of converter? (4) Does the Thomson-Houston railway system run on the three-wire system?

C. A. P.

(1) A brake h. p. usually designates the actual net power of any prime mover to do external work. It is used in contradistinction to indicated or electrical h. p., which is the greatest h. p. developed in or supplied to the engine or motor. It is called a brake h. p. because it is that work which would be done on, and is frequently measured by brake to the fly-wheel or other moving parts. (2) There are plenty of them in use by any of the companies supplying alternating current. (3) Such meters are ordinarily put into the house which is to be supplied, and consequently in the consumer's secondary circuit. (4) Not customarily. Of course, it or any other railway system could be operated on the three-wire system, if it were desirable. We cannot say whether the Thomson-Houston Company has tried the experiment or not.

Business Notices.

Steam Pipe and Boiler Coverings.—The H. W. John's Manufacturing Company, 87 Maiden Lane, N. Y., make a specialty of applying their coverings in any part of the United States. Send for estimates.

The Battery Cut-Out sold by the Electric Supply Company, of Syracuse, N. Y., 105 South Warren street, is cheap. Thoroughly tested, it is giving complete satisfaction. It automatically prevents the short-circuiting and damaging of gas lighting and other batteries. Send for circular.

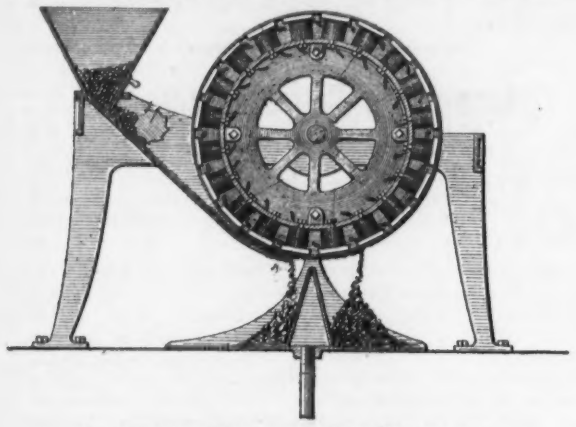
OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

U. S. Patents Granted June 24, 1890.

430,606. Magnetic Power Equalizer; William W. Alexander, of Kansas City, Mo., Assignor to the Gill-Alexander Electric Manufacturing Company, of same place. Application filed April 23, 1889. The combination of an electro-magnet and a toggle with an armature having one end hinged to one pole of said electro-magnet and the other end connected to the toggle.

430,607. Electro-Mechanical Combination Lock; William W. Alexander, of Kansas City, Mo., Assignor to the Gill Alexander Electrical Manufacturing Company, of same place. Application filed May 7, 1889. The combinatoin of an electric circuit, a wheel, its shaft and a coiled spring, said wheel, spring and shaft forming part of the circuit and the wheel carrying a contact to actuate the circuit, and a stationary metallic connecnection in the path of the contact, whereby the contact forming forming a part of the wheel is adapted to close the circuit.

430,608. Electro Mechanical Combination Lock; William W. Alexander, of Kansas City, Mo,, Assignor to the Gill-Alexander Electric Manufacturing Company, of same place. Application filed May 17, 1889. The combination of an electric



No. 430,758.—MAGNETIC ORE SEPARATOR.

circuit, a disc forming part of the circuit and having a series of notches at regular intervals, a contact upon the disc to actuate the circuit, and a stationary metallic connection in the path of he contact, a spring upon the shaft of the disc with a disc having notches at irregular intervals and means to actuate and retain the discs.

430,622. Electric Lamp Support; James Chase, of Rochester, N. Y. Application filed Sept. 21, 1889. The combination with a lamppost, of a suspended rising and falling lamp, an oscillatory contact or switch lever, and a rocking tripping arm or lever connected with the contact or switch lever and rocked by the descent of the lamp to cut the latter out of circuit.

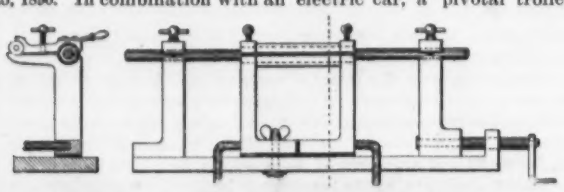
430,634. Regulator for Dynamos; William Henry Elkins, of Boston, Mass. Application filed June 10, 1889. In combination, two armatures, the brushes, the main circuit, conductors, of which a rheostat forms a part, connecting the like brushes of the armatures conductors, of which a rheostat forms a part, connecting one brush of one of the armatures with the main circuit, and conductors, of which a rheostat forms a part, connecting each brush of the other armature with the main circuit.

430,636. Electrical Circuit Controlling Apparatus; Edwin R. Gill, of Pleasant Hill, Assignor to the Gill-Alexander Elec. ric Manufacturing Co., of Kansas City, Mo. Application filed March 30, 1888. An escapement device having contacts at predetermined intervals and detents at intervals, a lever having short and long limit pawls alternately engaging the detents, an electro-magnet operating the lever, a cord wound under tension upon the shaft of the escapement device for giving progressive movement to the escapement device.

430,637. Automatic Signal and Switch Controlling Apparatus and Verifying Mechanism. Edwin R. Gill, Jr., of Pleasant Hill, Assignor to the Gill-Alexander Electric Manufacturing Company, of Kansas City. Mo. Application filed April 16, 1888. The combination of an automatic railway switch and visual signal and means to connect the switch with an escapement mechanism, an electric circuit and an escapement device provided with a predetermined combination of electric contacts, one alone of which renders the switch or signal operative, and an electro-magnet, whereby the device is restored to normal position when a wrong combination of pulsations operates on the escapement device.

430,645. Incandescent Lamp Hood; John Reath, of Plymouth, Mass. Application filed Feb. 21, 1890. An incandescent lamp hood comprising a hood proper suitably supported and having an upward enlargement at an apex and guards leading from the apex to its outer edges, in combination with the wires passing inwardly through the guards, turning downwardly within the enlargement and connected with an incandescent lamp at their lower ends.

430,675. Trolley Carrier; David C. Nelson, of Quincy, and Walter R. Eaton, of Cambridge, Mass. Application filed March 25, 1890. In combination with an electric car, a pivotal trolley



No. 430,839.—ELECTRICAL METAL WORKING.

carrier secured in a standard placed upon the roof, an actuating lever rigidly attached to the carrier, a rod longitudinally of and about said car connecting with the lever, and mechanism for holding the rod in any desired position.

430,686. Switch for Electric Locomotives; Frank B. Rae, of Detroit, Mich., assignor to the Detroit Electrical Works, of same place. Application filed March 28, 1890. A switch consisting of a cylindrical body of insulating material, provided with two strips of conducting material surrounding the body, intervening strips partially surrounding the body, and a plate having steps and contacts arranged to bear on the strips and plate.

430,688. Commutator for Induction Generators for Telegraph Lines; Walter S. Richards, of Boston, Mass., Assignor of one-half to Geo. B. James, of same place. Application filed Oct. 11, 1889. The invention relates especially to a device for generating a continuous current of the same direction from the secondary wires of an induction coil.

430,690. Electric Railway; William Robinson, of Boston, Mass. Application filed Oct. 21, 1889. In an electric railway system the combination of a contact or working conductor and a damper, arranged to prevent or absorb the vibrations of the conductor.

430,696. Insulator; William H. Seamon, of Holla, Mo. Application filed Feb. 17, 1890. An insulator having an exterior screw thread and parallel passages for conductor and tire wire, formed integrally.

430,722. Arc Lamp; James J. Wood, of Brooklyn, N. Y. Application filed April 7, 1890. In an arc lamp the combination of opposed main and shunt magnets, an armature and armature lever connected through a loose pivotal connection adapted to permit of the armature moving independently of the lever when abnormally attracted by the shunt magnet.

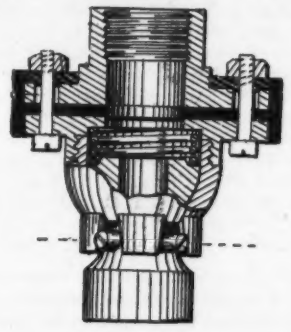
430,748. Telephone Exchange Key Board Apparatus; Joseph John O'Connell, of Chicago, Ill. Application filed Sept. 30, 1889. The invention consists of telephone exchange systems in which multiple switchboards are employed, and is adapted for use in such systems employing both metallic and grounded or single telephone lines connected with the same switch boards.

430,747. Telephone Exchange Apparatus; Joseph J. O'Connell, of Chicago, Ill. Application filed Sept. 30, 1889. The combination, with a battery in a ground circuit, of a condenser in a shunt around said battery and several metallic telephone circuits having each a branch connected through high resistance to the ground circuit which contains the battery.

430,758. Magnetic Ore Separator; Harris B. Smith, of Bridgeport, Conn. Application filed October 23, 1889. In combination with the hopper and shute, a spreader adapted to revolve against the flow of ore and provided with ratchet shaped lags.

430,764. Electric Lock; Charles B. Beers and William B. Tuttle, of Bridgeport, Conn. Application filed November 16, 1889. The invention relates to certain new and useful improvements in locks and latches which are operated by the usual knob and spindle attachment.

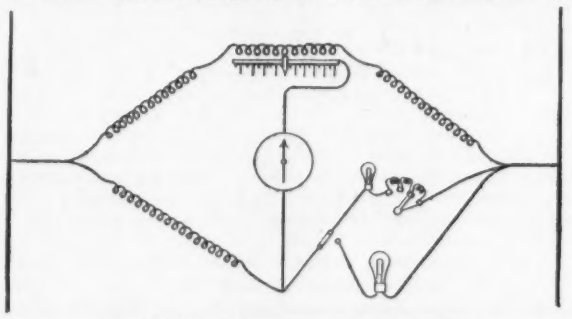
430,804. Electrical Calculating System; Herman Hollrith, of St. Louis, Mo. Application filed January 4, 1887. The improved system for automatically effecting mathematical computations and indicating the result obtained by means of a series



No. 430,846.—INSULATING JOINT.

of registering devices, consisting in the combination, with each of the registers, of an electrically operated controlling device included in an independent line or circuit, an integrating device and a series of wires or circuits connected thereto and operating to produce in each of the last named wires a separate series of electrical impulses, a gencrator, and the switch for connecting any one or more of the wires or circuits leading from the integrator with any one or more of the circuits containing the operating mechanism of the registers.

430,838. Method of Electric Welding or Metal Working; Mark W. Dewey, of Syracuse, N. Y., Assignor to the Dewey Corporation, of same place. Application filed Oct. 14, 1889. The method of electric welding or metal working, consisting in placing the bar or blank in proximity to an electric heat-radiating conductor and then passing an electric heating current through the heat-radiating conductor, partly or wholly surrounding the con-



No. 430,865.—ELECTRICAL INDICATOR.

ductor by a refractory or non heat conducting material, thereby raising the temperature of the work to the required extent and then welding, working or treating the work as desired.

430,839. Apparatus for Working Metals by Electricity; Mark W. Dewey, of Syracuse, N. Y., assignor to the Dewey Corporation of same place. Application filed April 9, 1890. In an apparatus for electric welding and metal working, a continuous electric heating conductor adapted to inclose the work and provided with a lining of carbon.

430,846. Insulating Joint; Emil F. Gennert, of New York, N. Y. Application filed November 23, 1889. In fixtures for gas and electric lighting, a ball and socket joint consisting of a nipple, having a semi-ball shaped portion and provided with projections, which are external to the casing forming the socket, in combination with the casing forming a socket for said semi-ball shaped portion and provided with lugs which are adapted to engage with the said external projections on the nipple.

430,865. Electrical Indicator; Harry Ward Leonard, of New York, N. Y. Application filed March 24, 1890. The combination, with a current indicator, the circuits of which are normally balanced and one branch containing a varying resistance, of a constant standard resistance normally out of circuit, means for changing the circuit from one resistance to the other, and means for restoring the balance.

430,868. Regulating System for Electric Circuits; Cyprien O. Mailloux, of Brooklyn, N. Y. Applicacation filed Aug. 29, 1890. For description see page 2, this issue.

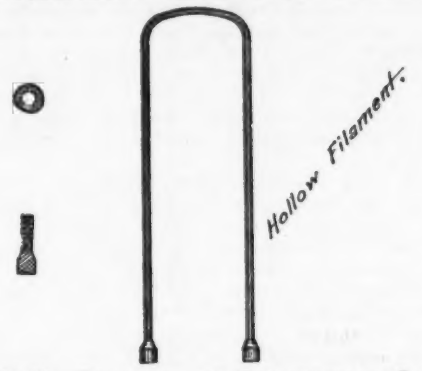
430,913. Telephone Mouth-Piece and Holder; Elizabeth B. Bell, of Washington, D. C. Application filed Nov. 6, 1889. As an improved article of manufacture, a telephone mouth piece, formed with the mouth end upon curved lines, and with an inwardly extending curve of the mouth-piece forming a sharp spherical angle at their junction.

430,926. Suspending Device for Electric Conducting Wires; William M. Davis, of East Weymouth, Mass. Application filed Jan. 23, 1890. A suspending device for electric conducting wires, comprising a suspending block and a supporting block, the latter adapted to be seated in a recess in the former.

(1) 430,932. Manufacture of Incandescent Lamps; (2) 430,934. Electric Lighting System; Thomas A. Edison, of Menlo Park, N. J. Application filed (1) Oct. 20, 1882. (2) June 29, 1883. (1) The process of exhausting the inclosing globe of an incandescing electric lamp consisting in filling the globe with a liquid, inverting the globe, heating the globe, and expelling all of the liquid by the tension of the vapor produced by the heating, and again heating the globe externally to expel the vapor, the carbon filament of the lamp being heated to incandescence by an electric current during the latter external heating. (2) The combination, with an electric circuit, of the electric lamps operative with either polarity of current connected in the circuit, means for reversing the polarity of the current in the circuit, and polarized electrical apparatus connected in a branch of the same circuit outside of the reversing device and operative without changing the main lamp circuit, whereby the polarized apparatus may be controlled without affecting the lamps.

430,933. Filament for Incandescent Lamps; Thomas A. Edison, of Menlo Park, N. J., Assignor to the Edison Electric Light Company, of New York, N. Y. Application filed Nov. 9, 1887. A tubular incandescing conductor for an electric lamp.

430,974. Electric Connection; Hercules Sanche, of Detroit, Mich., Application filed Dec. 9, 1889. The combination, with the meeting ends of wires or wire cables, of a terminal piece and companion piece on the end of each wire, shanks connecting each



No. 430,933.—FILAMENT FOR INCANDESCENT LAMPS.

terminal to its companion piece, the ends of the wires being coiled around the shanks, and a connection between the two companion pieces.

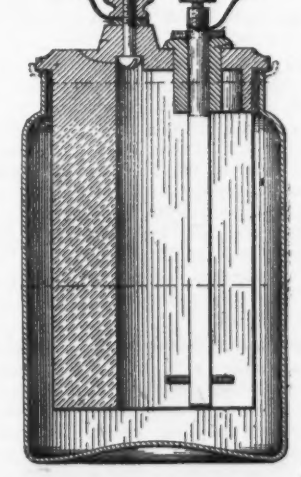
430,990. Galvanic Battery; John A. Davis, of Findlay, O., Assignor to Yeatman Bickham of one-third interest. Application filed Feb. 14, 1890. In a battery, a carbon electrode provided with a circumferential outstanding flange to rest upon the edge of the neck of a battery jar, having the flange and the adjoining portion of its body for a short distance downward solid, and the remaining portion of its body rendered exceedingly porous by intersecting or communicating for a wire extending through it in various directions.

431,991. Carbon for Electrical Purposes and the Process of Making It; John H. Davis, of Findlay, O., Assignor of one-third to Yeatman Bickham, of same place. Application filed Feb. 14, 1890. Carbon composed of calcined and grouad shale and adhesive substance.

430,992. District Police and Fire Telegraph; Charles C. Drake, of Trenton, N. J. Application filed Nov. 4, 1889. The combination, in a single call box, of a single wheel and its actuating mechanism with a circuit closer, raised tooth, acting upon the circuit closer and receiving its motion from the handle of the signal wheel, and a key in the open circuit whereby the key can be operated by hand to signal the central station while the handle is drawn down and the circuit closer closed.

431,011. Electric Railroad Signal; William J. Smith, of Charlottesville, and James Walter Fox, of Lexington, Va., Assignors of two-thirds to Asher Ayres and George C. Jordan, both of Staunton, Va. Application filed Jan. 21, 1890.

431,017. Block Signaling for Railroads; Mahlon S. Conly, of Hyde Park, N. J. Application filed Feb. 15, 1889. In a block signaling system for railroads, the combination, with a series of signals and a corresponding series of electro magnets operating the same, the magnets being coupled in series and working on a closed electric circuit, of a series of relay or second-



No. 430,990.—GALVANIC BATTERY.

ary magnets operating by induction from the signal magnets for temporarily bridging or short circuiting the signal magnets.

431,018. Dynamo or Magneto Electric Machine; Thomas A. Edison, of Menlo Park, N. J., Assignor to the Edison Electric Light Company, of New York, N. Y. Application filed Feb. 21, 1881. Patented in England March 21, 1881. The combination, with the commutator, of an armature end composed of disks having tongues integral therewith for electrical union with the commutator.

431,020. Dental Engine Motive Gear; Peter Brown, of Montreal, Can. Application filed May 5, 1890. The combination, with a dental engine or the like, of an electric motor and connections, a disk on the armature shaft of the same, a counter shaft suitably carried, an adjustable friction wheel mounted on such shaft and adapted to be shifted along the same, so as to make contact with the disk at various points, and a treadle with connections for adjusting the friction wheel.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patents issued since 1866—can be had for 25 cents. Give the date and number of patent desired, and address The W. J. Johnston Co., Ltd., Times Building, N. Y.